ENVIRONMENTAL ASSESSMENT BOARD

Ontario

ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

VOLUME: 137

DATE: Wednesday, April 22, 1992

BEFORE:

HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

FARR & ASSOCIATES REPORTING INC.

(416) 482-3277

2300 Yonge St. Suite 709 Toronto, Canada M4P 1E4

ENVIRONMENTAL ASSESSMENT BOARD
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act, R.S.O. 1980, c. 140, as amended, and Regulations thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro consisting of a program in respect of activities associated with meeting future electricity requirements in Ontario.

Held on the 5th Floor, 2200 Yonge Street, Toronto, Ontario, Wednesday, the 22nd day of April, 1992, commencing at 10:00 a.m.

VOLUME 137

B E F O R E :

THE HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

S T A F F :

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A P P E A R A N C E S
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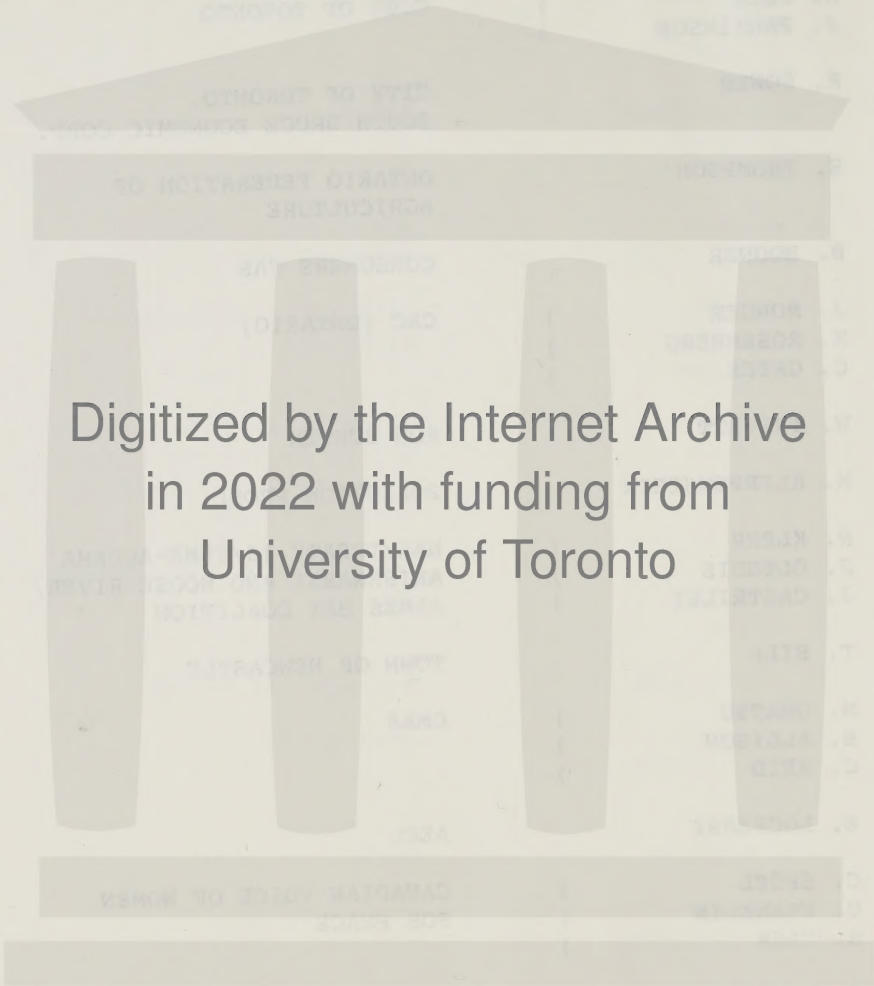

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L. BULLOCK L. CHAN	))	CANADIAN NUCLEAR ASSOCIATION

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L I S T o f E X H I B I T S

TIME NOTATIONS

---Upon commencing at 10:05 a.m.

THE REGISTRAR: Please come to order. This hearing is now in session. Be seated, please.

THE CHAIRMAN: Mr. Poch?

MR. D. POCH: Good morning, Mr. Chairman.

DAVID WHILLANS,
KURT JOHANSEN,
FRANK CALVIN KING,
WILLIAM JOHN PENN,
IAN NICHOL DALY; Resumed.

CROSS-EXAMINATION BY MR. D. POCH (Cont'd):

Q. Panel, when we left off we were talking about probabilistic risk assessment and I just wanted to turn your attention to page 156 of our materials.

THE CHAIRMAN: That's Interrogatory 9.7.14?

MR. D. POCH: Yes.

THE REGISTRAR: Sorry, which one are we on, please, Mr. Poch?

MR. D. POCH: This is in the first volume of materials, Exhibit 577, at page 156.

THE REGISTRAR: 9.7.14 is .114.

THE CHAIRMAN: Thank you.

---EXHIBIT NO. 520.114: Interrogatory No. 9.7.14.

MR. D. POCH: Q. Mr. King, I wanted to ask you, since you have agreed that probabilistic risk

assessment is something that came out of the U.S. experience, and we have indicated that they are at the point where they are able to do or they are doing probabilistic risk assessment, at least in some jurisdictions, that captures the number of categories such as external initiators, that your risk assessment doesn't.

I was interested in your response to 9.7.14 which makes clear that you don't have any external reviewers, independent external reviewers, critiquers, if you will, of your probabilistic risk assessment from the States, or from Canada for that matter.

MR. KING: A. External to what?

Q. External to yourself and the AECB presumably?

A. Well, we have the group of people who prepare the risk assessment, external to that group but still within Hydro. We have reviewers.

Q. I am talking about external to Ontario Hydro.

A. External to Ontario Hydro we have the AECB.

Q. Wouldn't you agree, Mr. King, if the object of the exercise is to look for all of the risks,

and I understand that the object of the DPSE wasn't to capture all of the risks, but was to look for cross linkages and to uncover potential problems, wouldn't you agree that it would be healthy to have sort of detached and critical suitably skeptical analysts critique your report? Wouldn't you think that would be a positive way to try to uncover gaps?

A. I think the AECB staff are very skeptical.

Q. Going back to Exhibit 525.

A. Can you refresh my memory on which --

Q. This is the report we produced.

THE CHAIRMAN: Hazard report.

MR. D. POCH: Hazard report.

Q. First of all, Mr. King, I gather from the fact that you checked the numbers we produced for the Pickering experience going back some years, you didn't mention you have any difficulty with the chart that appears on page 9 of this -- sorry, it's page 9 I wanted you to refer to, where we simply plotted the results from '89 and '90 for the various stations.

MR. KING: A. You have plotted selected results.

Q. Yes. This is the one selected by the methodology indicated in the report where there was the

four digit code and where they were available in your --

A. You have selected those systems on those units on those stations where the targets have been exceeded, I believe.

Q. Yes. Sorry.

I take it that these results again conform with your understanding?

A. Yes, I have checked these results.

Q. Now, I am wondering why it is that you find an arithmetic average - these aren't averaged, the other were - but why you find the arithmetic average an unhelpful way of expressing this?

A. Our discussion yesterday on that point wasn't on this page right here.

Q. No.

A. But I think as I explained yesterday, these are annual targets. They are meant to be used on that performance on that year.

I think that one chart, that one table that we were looking at had a number of 20 years of experience on Pickering "A" ECI, I guess it was, where the total unavailability in units of 10 to the minus 3 was 1,400 and some odd, where two years contributed 1,240 of that total.

Q. Mr. King, I think Dr. Connell pointed out, there was no apparent time pattern to that data, agreed? I think you agreed to that.

THE CHAIRMAN: We are now talking about another table. We are not talking about the table on page 9 right now?

MR. D. POCH: Yes. We can go back to that one, if it's helpful to have it in front of us.

DR. CONNELL: Mr. Poch, just to correct that impression. My observation was that I thought the distribution pattern in the table seemed to me to be distinctly non-random.

MR. D. POCH: Oh. I apologize, Dr. Connell.

Q. I am just trying to find the location of it in our materials. It's in the second volume of materials at page 76.

Mr. King, I think, for example, if we take Unit 4, there were higher numbers in years three through eight and then there were some lower numbers interspersed with some higher numbers, and then in the latter years '88, '89 and '90 again we see -- rather '88 and '90 we see higher numbers.

I guess I still don't grasp the kernel of logic, if you will, in your concern about arithmetic

average. Aren't we talking about a number which is used or which can be used in a risk analysis or compared to your expectation of the likelihood of availability, or unavailability in a safety analysis, and wouldn't the entire history be relevant to that? If it has been out 50 per cent of the time and your target says it should be out 1 per cent of the time, isn't there is a 50 times the likelihood it will be out on any given day than you would estimate?

MR. KING: A. We don't and we can't use any of these data in our risk assessments because, as we have gone over several times, when a special safety system is declared unavailable--

Q. Fine --

THE CHAIRMAN: Let him finish.

MR. KING: --it doesn't mean that the system was unavailable in a way that is significant in your risk assessment model.

MR. D. POCH: Q. Mr. King, I think we discussed that at length, and I didn't mean to put that conclusion in your mouth.

All I am suggesting is to the extent that these are reflective of inadequacy, however serious in the safety systems, why is an arithmetic average not representative of the availability or unavailability?

MR. KING: A. Okay, pick a column. You want to pick column 4, arithmetic of average of 111. That is an unavailability average, now what is your definition of the unavailability of the system?

Q. Well, again, I think you are returning to the other point you have made which is --

A. That's the important point, that is why I am returning to it.

Q. Let me understand then. You are not objecting, if these numbers were, say, for total unavailability, complete unavailability, complete inoperability, you wouldn't object to my averaging them over a number of years. What you object to is that they aren't all for total inoperability; some of them are only for partial.

A. That's my major objection.

Q. That is fine. I wanted to understand if it was a mathematical as opposed to the other point you have already made.

Now, with respect to the future, are you offering us any prediction on how the safety system, special safety availability will trend? Are you expecting to remedy this mixed record that you spoke of?

[10:16 a.m.]

A. The quality improvement process that Mr. Daly talked about had in 1991 -- of the various performance measures, and there are many of these, covering all aspects of station operation, that was one of the ones they were focusing on, one of the six they were focusing on for improvement.

We do expect improvement--

Q. All right.

A. --in the future.

Q. Mr. King, this question of safety system availability being below target or expectation, this is a long-standing problem, is it not?

I mean, you have been aware of it, I think we have established the long-standing problem at least with respect to Pickering "A", but you have been aware of it for a long time, have you not, Mr. King?

A. There are two problems: 1, the unavailability of systems where that unavailability is a real unavailability, and there is a problem with respect to the whole system of reporting unavailability, and some of these problems which I have been talking about, you know, perhaps it is time we came up with a new system to report unavailability to make it more accurate with respect to the actual increased risk that may be involved with that

unavailability.

Q. Mr. King, could you turn to page 157 of our first volume of materials?

A. I have it.

MR. D. POCH: This is an excerpt from A Race Against Time, which is the interim report of the Royal Commission on Electric Power Planning, the Porter Commission, on nuclear power. I believe that may already be a exhibit. I am not sure though, Mr. Chairman, I'm afraid.

Perhaps we should get an exhibit number for it. It is excerpts from the Royal Commission on Electric Power Planning Report, A Race Against Time.

THE CHAIRMAN: We probably have it somewhere. I don't know whether the Porter Report is an exhibit or not.

MR. D. POCH: Perhaps Mr. Campbell can help us here. Why don't we proceed while they look for that.

Q. Mr. King, if you look in the lower right-hand corner of the page there is a paragraph there. This occurs inside a discussion of what the probability of a reactor accident was thought to be at the time.

Dr. Porter points out that:

Two well-informed nuclear critics who participated in the hearings, Dr. Gordon Edwards and Ralph Torrie have argued that the probability of a dual failure could be about 100 times higher than the theoretical levels. This estimate is based on failure rates in the high-pressure piping of the primary heat transport system being 10 times higher than has been assumed and also on the fact that the availability of the Pickering ECCS has been demonstrated to be 10 times lower than postulated by designers. We believe that the Edwards, Torrie estimate is more realistic than the theoretical probability.

And he goes on to consider the U.S. experience.

Do you disagree with the findings, the applicability of those findings in 1980 to the current situation? Do you believe that your various systems are performing at the level envisaged by your designers, or do you acknowledge that your plan to improve quality evidences the fact that they are not performing to design?

MR. KING: A. In that paragraph you just

read, there are two components. There is the initiating event frequency and then there is the ECI unavailability.

On the first part of it, well, they are referring to theoretical levels. I am not sure what they were referring to when they talk about theoretical levels, and this statement about the frequency of failure of high-pressure piping being 10 times higher... If anything, in the time frame since this was written our estimates have gotten lower, not higher.

On the second part --

Q. Mr. King, I didn't mean to refer you to the particular items referred there. I was referring to the observation that the actual unavailability was demonstrably worse than the design expectation, and I am wondering if you would agree that that has been the experience and remains the experience?

A. Well, you read the whole paragraph and the first part of that paragraph too, so I think in order to have some perspective I should comment on that as well.

Q. Well, perhaps you could answer my question first and then go on to add whatever other

comments you want. That might shorten things up considerably.

MR. B. CAMPBELL: Well, with respect, Mr. Chairman, if my friend insists on reading in a whole bunch of stuff and then asks a question I think it is fair for the witness to conclude that he should answer based on all of the material that is put in front of him - not a particular part, the whole having been read.

THE CHAIRMAN: Mr. King, you just continue with your answer and in the course of it deal with Mr. Poch's question.

MR. KING: As I was going on to the next point in there was the second part, which is the Pickering ECCS. Well, as we have discussed and as you have shown on that table yesterday, whether it is 10 times or some different number of times it is less than the 3 times 10 to the minus 3 for Pickering "A", which is the design target.

There is no dispute about that.

MR. D. POCH: Q. All right.

MR. KING: A. But you just can't go from that to an increased risk of some high-level consequence because there is a whole chain of events that have to occur. The initiating event has to occur,

and I was just commenting on the frequency of that.

And Dr. Porter continues in that same sentence, not least because, which you didn't read - the Rasmussen report concluded. So what was in the Rasmussen report led or helped Dr. Porter reach his conclusion there.

In fact, I disagree I believe Dr. Porter in error has taken materials from the Rasmussen report.

Q. Well...

A. I have the excerpts from the Rasmussen report which clearly show that he has not taken the material correctly from it.

Q. Mr. King, I thought we had already established that when we are talking about risk if we presume that the initiating event is at a frequency as you predicted, the fact that a special safety system has a frequency of availability less that you predicted does increase the risk of a major consequence event, does it not?

It doesn't matter for the reasons we spoke of; it is the multiplication of probabilities that gets you the final probability?

A. As we discussed yesterday, it increases the probability of that sequence.

Q. Yes.

A. That sequence may be an insignificant contributor to the total probability.

Q. Yes, I understand that.

Now, could you comment on my question? Despite your caveats would you agree that the special safety system performance has in fact not been performed at the level anticipated by the designers?

A. That's correct. I have said that in my direct evidence, and I have said it to you several times already.

Q. And, Mr. King, you would agree that in some instances the lack of performance -- I think your point is in some instances it may be of more concern than in other instances?

A. Yes, that would be generally true.

Q. All right. Now, Mr. King, I understand that the U.S. Oak Ridge National Laboratory has developed something called an Accident Sequence Precursors study for the NRC there. Are you familiar with that?

A. I'm familiar with that that program is in existence. I'm not familiar with the details of the program.

Q. Perhaps we can go a little ways down that road.

I understand that as a result of that in the U.S. each year the LERs, which are equivalent to your SERs, are reviewed and accident probabilities are estimated based on the pathways presented in those real life events, and that information provides insight into what needs to change, both in the probabilistic risk assessments and on the ground in the plants.

Do you have something analogous to an accident precursor program as a formal process in Hydro with the AECB?

[10:25 a.m.]

A. We don't have a program which is similar to the scope of that NRC program.

The AECB did start a program maybe five years ago which involved looking at precursor sequences and looking at actual occurrences, but I am not sure how far that got along and whether it's still active.

Q. All right. Mr. King, I would like to talk about comparative risk. In your oral evidence and in Exhibit 507, I believe, have compared the risk of nuclear to other risks we face, be they energy or in every day life. Your comparisons are based on your assessment of accident risk in Exhibit 507 which is drawn for the most part from your probabilistic risk assessment?

A. If we go to 507 you will see there is for the accident public radiological risk it comes in two components, one from the Darlington study, and as we discussed yesterday, a conservative estimate based on some American work.

Q. So to the extent that your probabilistic risk assessment isn't complete, and you have indicated it wasn't intended to be complete, to the extent it leaves out, for example, external initiators, then those comparisons would similarly leave out those initiators and that risk?

A. Yes. But it's my judgment that those extra contributors are small.

Q. And I take it that whatever the extent of that failing, it would be shared by many of the other comparative risk estimates we have seen, for example, from the AECB or as presented to you in evidence?

A. Could you clarify that? What other comparisons? AECB comparisons?

Q. Perhaps we will get to that in a minute then in specifics.

Could you turn up Exhibit 558 which was the piece filed by AECB with respect to the Helsinki key issue paper. I just wanted to be clear. If you

turn to page 133 of that report.

A. I have it.

Q. At page 133 of that report there is the chart, Normalized Fatality Rates for Severe Accidents, and there is a note which says reported fatalities are in terms of immediate fatalities. Delayed fatalities, particularly relevant for the Chernobyl accident, are not included.

Would you agree that delayed fatalities are indeed particularly relevant for nuclear compared to other technologies?

A. They are particularly relevant for nuclear.

Q. All right. And do you have any estimate to offer of what delayed effects are predicted to be for Chernobyl?

A. I do not. The literature has wide ranging estimates from different bodies. It's sometimes --

Q. Can you give us a range that you are aware of?

A. No, I can't.

Q. Would you agree that the upper estimates have ranged into the hundreds of thousands?

THE CHAIRMAN: You are talking about

fatalities now?

MR. D. POCH: Yes.

MR. KING: Well, I just don't have that information.

MR. D. POCH: Q. You have not read such reports, Mr. King?

MR. KING: A. I have seen Nucleonics Week-type articles. I have seen numbers, there is numbers per year, there is world-wide, there is local.

Q. I was thinking of world-wide delayed effects.

A. The ranges from the various sources, I don't put much -- when I read it, somebody comes up with a number, I don't put much credence in it unless I am aware of the scope of the studies that went in and the bodies that made those estimates.

Q. And since you are not prepared to offer us any number, I take it you are not comfortable with any of the results of any of these studies to date?

A. Which studies are we talking about?

Q. Any of these that you have read about in Nucleonics Week or wherever else that you don't put much credence on.

A. I prefer to see the studies in front

of me rather than a newspaper or short clips on results of studies.

Q. You haven't made it your business to review those studies then I take it.

A. No, I haven't.

Q. And if we turn to Exhibit 562,

THE CHAIRMAN: What is Exhibit 562, please?

MR. D. POCH: I am just going to find it, Mr. Chairman. It was an AECO report which appears in the Volume 3 of the AECL materials behind tab 3, I believe anyway.

Excuse me, I think I have got the wrong cite. I'm sorry, it's not an AECL report, but it is further material from the Helsinki materials.

Q. I just wanted to confirm, if you would, Mr. King, that this report similarly --

THE CHAIRMAN: Just a moment. We better identify the report. It is in AECL's Volume 3 and it is behind tab 3.

MR. D. POCH: Yes. It's been given Exhibit 562. It's the Senior Expert Symposium, Executive Summary from Helsinki. It's an IAEA publication.

THE CHAIRMAN: 1991.

MR. D. POCH: Yes.

Q. And, Mr. King, this discussion here of relative risks of difference fuels, for example, on page 10, if you look at the top right-hand column on page 10 you will see that in the first paragraph, 31 immediate deaths, and it notes at the bottom of that, although risk of delayed fatalities has yet to be established, the social consequences of the accident are particularly significant.

Would you agree that the comparison or conclusions drawn in this report are based simply on the 31, not on the latent health effects?

MR. KING: A. I can't confirm that at all. I haven't read this report.

Q. That is fine. And if you would take a look at the first volume of AECL's materials, at tab 15.

A. Exhibit number, please?

Q. I am afraid I don't have the exhibit number. It was Interrogatory 9.15.5.

A. We have got everything in exhibit number over here.

Q. Perhaps Mr. Lucas could help us.

THE REGISTRAR: Where are we?

MR. D. POCH: Tab 15.

THE REGISTRAR: 9.15.5 is .43.

MR. KING: What is the title of that?

MR. D. POCH: Q. This is an interrogatory on occupational health effects and there is two reports attached to it, one of them is Cohen and Pritchard on comparative risks and the other is from ACNS 10.

MR. KING: A. I may have the right volume here. 520...

MR. B. CAMPBELL: What is the interrogatory number?

MR. D. POCH: 520.43.

MR. KING: I have a Cohen and Pritchard paper.

THE CHAIRMAN: It was written in 1980 I notice on here.

MR. D. POCH: Q. I am looking at the second report behind the tab, it's halfway through. Unfortunately the pages are not numbered. It's the Advisory Committee on Nuclear Safety.

MR. KING: A. ACNS 10 document?

Q. ACNS 10, and this is the Advisory Committee to the Atomic Energy Control Board?

A. Yes.

Q. This is the study which you cite in

your Exhibit 507 as one of the studies that you compare your results to?

THE CHAIRMAN: Let's get it straight which one we are talking about. The one that I have in here is the second paper, the paper by Cohen and Pritchard.

MR. D. POCH: I am sorry. No, I think there is a response to the interrogatory and then there is a paper by Cohen and Pritchard and then about a quarter of inch of material later, an eighth of an inch of material later there is ACNS 10.

THE CHAIRMAN: Which one are we looking at?

MR. D. POCH: ACNS 10. The cover page is like this.

MR. KING: They are in Exhibit 507, there is a table in there where we compare the results that we calculate in Exhibit 507 to a number of other sources, the ACNS being one of those sources.

MR. D. POCH: Yes.

THE CHAIRMAN: This was one published in 1989, just to keep that in perspective.

MR. D. POCH: Yes.

Q. And if we look at the page Arabic numeral 4.

THE CHAIRMAN: The page which starts with the words "Inclusion of different types of harm"?

MR. D. POCH: That's correct, Mr. Chairman.

MR. KING: I have it.

MR. D. POCH: Q. And there, there is a review of the other studies which ACNS looked at and if we look towards the bottom half of the page it notes that Cohen and Pritchard, halfway through the second section there, Cohen and Pritchard draw only qualitative conclusions, so the usefulness they note is somewhat limited.

Paskievici recommends best estimate values, and they go on to offer the bases for the choices of these values, which are enumerated A through F. And if you note, D says, long-term risks greater that 500 years are ignored or discounted, and in E, risks of large scale hypothetical accidents are excluded, thus low probability but high consequence nuclear reactor accidents are not considered nor are such accidents as large explosions at oil refineries.

MR. KING: A. This is with respect to the Paskievici study, I assume?

Q. Yes. You don't disagree with that, I take it?

A. I haven't read the Paskievici.

Q. And Niehaus, after the enumerate paragraph, they refer to Niehaus and colleagues, use an approach similar to that of Paskievici, they do not include the effects of hypothetical severe accidents. And then if you look at the paragraph below that, thus it is concluded that had the bases of the critical surveys of Paskievici and Niehaus are reasonably comparable. The results of these studies are used as the basis of this report.

[10:44 a.m.]

So would you agree that the ACNS studies similarly leave out low probability/high consequence events?

A. I would have to read this whole report again. I read it a couple of years ago, but --

Q. So you are not aware of whether the ACNS 10 conclusions include high consequence events or not; is that the answer?

A. Well, I can't confirm that one way or the other until I look at this report.

Q. Mr. King --

A. Now, what you are referring to is just a section of the report entitled, Recent Critical Evaluations of the Literature. I would assume that if

ACNS had made such an exclusion they would have that up front in some other part of the report here.

Q. I would have hoped so, too.

A. In any case, we didn't use the ACNS report to come up with our 507 estimates.

Q. No, you offered them as comfort for why your 507 estimates seemed reasonable, I think; is that fair? They are presented, for example, at page 5-23?

A. Yes. Well, we have got UNSCEAR, Hamilton, ACNS, Fritzsche.

Q. ACNS, for example, appears to be about twice as high as yours, and if I am correct they don't even include the high consequence events, do they.

A. Well, I can't confirm that, but I know there is a discussion on page 522 of Exhibit 507 which explains why the information from the other sources are higher in some cases. I am aware that in the ACNS 10 report they used occupational dose data, which is a major contractor, which was only data up to 1984.

Q. Well, Mr. King --

A. And that data, as you have seen from Dr. Whillans, the occupational dose data is going down,

and, in fact, it is twice as high as what we have used because they have more recent information.

Q. Mr. King, it seems what you have done is you have pointed out the places where ACNS appears to overestimate risk from your perspective, but you haven't reviewed this and you are not able today to tell us or agree whether or not ACNS has underestimated risks in other regards, and explicitly done so?

A. Exhibit 507 is our estimate of what these risks are, and we have included contributions from large accidents.

Q. Finally, with respect to comparisons of risk AECL tabled Exhibit 550. This was the large tome entitled: Energy For 300 Years.

A. I haven't read that - yet.

Q. I won't ask you to.

THE CHAIRMAN: 550, did you say?

MR. D. POCH: 550.

MS. PATTERSON: You can go ahead.

MR. D. POCH: Q. Mr. King, I just wanted to direct your attention to page Roman numeral 9. This is in the summary that they offer, the authors of that report offer under the heading Assessment of Risks of Environmental Impacts of Energy Alternatives.

MR. KING: A. Roman numeral 9?

Q. Page Roman numeral 9.

A. Yes?

Q. And their conclusion, it seems to me, can be captured in the paragraph which is the second from the end there, after the indented section, which reads:

> None of the options for supplying the needed extra energy presents any appreciable risk to life or health. Constraint on energy use or excessive conservation option that is not meeting the demand would result in the biggest risk because of the slowing down of the rate of increase of life expectancy that can be expected to occur.

Would you agree that the assumption inherent in this -- and I think if you just literally flip the pages you will see page after page after page of correlations being analyzed between electricity, use and GDP, and so on, and life expectancy and GDP. Would you agree that to accept that conclusion one would have to accept that there is a correlation between electricity use and GDP and in turn between GDP and life expectancy?

A. When Mr. Heintzman was taking me

through some of this material here I believe I answered I just wasn't familiar with this material and I couldn't answer any questions associated with that.

If that is the conclusion in the report I assume it is stated in the report somewhere, and even if it is, I didn't do this work. I haven't read this report.

Q. All right.

A. I can't --

Q. I take it, it is not the suggestion of anyone on this panel that electricity use or production is in any way related in a causal way to life expectancy?

MR. PENN: A. Well, I would like to comment here, Mr. Poch.

There is clearly an established relationship between GDP and electricity growth. It is well known, if you plot the two they lie on top of each other for Ontario and right -- since about 1910. If you look at the United States or if you look at the United Kingdom there is not too dissimilar patterns. So that is the first point to make that you commented on.

These authors, of course, have been trying to wrestle with the question of the benefit of

various forms of energy to society as opposed to the risk. And the measure that they have used, according to my basic understanding - and I haven't read this report either, is the question of improved life expectancy over the century while electricity has been available.

Now, I am not going to defend whether the authors' correlation between life expectancy and electricity growth alone is the reason that we are all surviving longer, but clearly any person who has lived through the period would recognize the value of electricity to our lifestyle.

Q. Mr. Penn, I just want to ask you then, would you agree that in an era when we can provide the same end use service, the same for example hygiene or health service whatever it may be, warmth in one's home, with say conservation rather than electricity, to that extent this study is completely outdated?

A. Well, the study has only been just produced. You can't conserve, Mr. Poch, unless you have already got something to conserve.

Q. Yes.

A. And I certainly agree that we as a consumer society must conserve, and why we call our

plan the Balance of Power is to just recognize that point.

Q. Dr. Whillans, would you agree that a relationship between electricity per se as opposed to hygiene or what have you and life expectancy is an example of your ice cream cones and drownings at the beach?

DR. WHILLANS: A. I think any correlation is subject to that concern. It does not prove cause and effect.

Q. All right. Thank you.

A. While I am speaking, Mr. Poch, you didn't ask me about your estimate of 100,000 cancer deaths from Chernobyl although I gave the evidence on health effects.

Q. I don't think I offered any such estimate.

MR. B. CAMPBELL: Yes, you did.

MR. D. POCH: Q. Oh, I'm sorry. You are right. I asked if there were estimates ranging into the hundreds of thousands. Yes, you are quite right, Dr. Whillans.

DR. WHILLANS: A. Well, I would just like to comment that I think to my knowledge anyway, the estimates range from about 100,000 extra cancer

deaths to Dr. Thomas Luckey's estimate of 20,000 lives saved, and I think both of those estimates are quite extreme.

I think probably - and there is a great deal of uncertainty, as I described - probably the best estimates are something like 5,000 to 10,000 in a population of something like 100 million.

Q. And that is going out how far in time?

A. Well, I would presume it is mainly to the decay of caesium, which is one of the main contributors to these low levels. So that would be some hundreds of years, I guess.

Q. And you said a hundred --

A. It is based on the dose commitments.

Q. And you said 100 million. So that cuts off effects of very low doses --

A. Well, these are already doses below background in most areas. It is the population of Western Europe, some fraction of that.

Q. So that would not count effects from the globally dispersed?

A. I think it includes those because those are a small contributor.

Q. All right. I would like to just

touch on your safety philosophy, Mr. King. Could you turn to page 141 of our first volume of materials?

This is the excerpt from the Select Committee on Ontario Hydro affairs from 1980, which has been given Exhibit 633. Page 141?

MR. KING: A. Yes, I have that.

Q. I just noted the last reference on that page where it states:

> The Pickering, Bruce and Darlington plants are licensed to meet reference dose limits and reliability standards calibrated to ensure that the risk to the public is acceptable in relation to the risks from other industries.

Is that still a fair statement?

A. I don't think it was a fair statement when it was made.

Q. All right. Go ahead and explain, please.

A. Because they don't distinguish whether -- I haven't tried to read the pages around it to put it in perspective, but just looking at that one sentence that would be true if you were looking at normal releases, the normal dose limits applicable to normal operation, because those were derived from ICRP

recommendations, and the ICRP recommendations are based on background risks in otherwise safe industries.

Q. All right.

A. So it would be true from that point of view, but it doesn't distinguish whether it is talking about accident risks or -- accident dose limits or normal release dose limits

With respect to accident dose limits -- and, for example, the siting guide, if you will recall, for a dual failure has a 25 rem, a .25 sievert dose limit, and that is not set in that way. It was set in 1972 as the perceived threshold for nonstochastic health effects.

That is my understanding on how it was set.

Q. So that that number - and those are the pages 40 and 41 of your Exhibit 519 - this would be in the higher category, the lower probability category/high consequence category you were referring to?

A. Yes.

Q. And the number there is intended to be a number which assures none of the, I think they were called, deterministic effects as opposed to the stochastic effects?

[10:55 a.m.]

A. Deterministic and non-stochastic is the same thing.

Q. So that isn't intended to be a number which eliminates cancer or genetic effects. That's a line that's drawn where if you exceeded it one would expect to see some, there would be some risk of the sort of cell-killing immediate effects.

A. You recall there is two dose limits, there is the population dose limits and the individual dose limit.

My understanding is the individual dose limit was set with the objective in mind of not having any observable health effect that the time, i.e., the deterministic health effect.

The population dose effect, the dose limit in that case would be 10 to the 6th person rem, 10 to the 4th person sieverts. That was related to incidence of leukaemia in the population, but I can't explain it any further than that.

Q. All right. We have had a discussion earlier about the formula that's commonly used, although not exclusively used, I think you pointed out for risk, that of probability times consequence. Would you agree that acceptability of risk, in fact, is not

based on such a formula in the case of extreme consequence events?

A. Acceptability by whom?

Q. By the public.

A. The literature has a number articles on acceptability of risk and whether the public has a perceived risk - I forget the name of the word - but it's consistent with what you are expressing, that at high levels of consequence, even though the risk may be lower or the same, that they find that less acceptable.

Q. Right.

A. But my reading of the literature would suggest that that's only true in the surveys that I am familiar with where the consequence is in fact immediate fatality rather than delayed fatality.

Traffic accidents that are occurring every day, one a day for 365 days a year has the same number of deaths as one huge accident causing 365 deaths, the public would find the latter less acceptable even though they are the same number of deaths over that year period.

Q. Let's test that a little without getting personal, Mr. King.

Do you have life insurance?

A. Yes.

THE CHAIRMAN: How is that not getting personal. [Laughter]

MR. D. POCH: I wasn't going to ask him to have tell me him limits, or anything, Mr. Chairman. Just Let's consider Mr. King for a moment is a reasonable man, if you will.

MR. B. CAMPBELL: On that admission we can proceed. [Laughter]

MR. D. POCH: Q. Mr. King, I take it you have life insurance because you find the financial consequence of leaving your family destitute if you should have an untimely demise too large to be accepted; fair?

MR. KING: A. I believe that's the reason why most people have it.

Q. So you have acted to try to avoid at least the financial consequence of premature death, and I trust you are acting to avoid the actual consequence too, but you are doing what you can within certain limits to limit that financial consequence?

A. Generally fair.

Q. Are you aware that insurance companies make a profit on people like you and me?

A. I guess so.

Q. And that's because the mathematical

formula of risk, probability times consequence, results in an expected cost to them which is less than they charge us in premiums, including the time value of money; fair?

A. Well, I think it's a little more complicated in that in they invest our money and get interest on that.

Q. Yes, and otherwise we would.

So the net present value of the premium, let's put it that way, exceeds what the formula tells us the expectation of risk is on average?

A. They are in business to make money.

Q. Yes. So, Mr. King, if you really believe that risk is purely probability times consequences, you wouldn't pay the premium which exceeds the mathematical result because nine times out of 10 you would be richer keeping the premiums and investing it yourself; wouldn't you?

A. Well, it is just something I don't, with respect to life insurance, I don't think about it at all.

Q. Well, I have just pointed it out to you. Are you going to keep your insurance tomorrow, Mr. King?

MR. B. CAMPBELL: With respect, Mr.

Chairman, I think my friend is being a little facile about mixing an individual choice and an insurance company's view of a pooled risk. I think if he is going to ask the question fairly, he has to deal with the concept of pooling of risk versus individual statistics of individual death.

MR. D. POCH: I am really try trying to illustrate, Mr. Chairman, that one's perception of risk and one's dealing with risk quite logically may not follow this linear formula. I wasn't looking at it from the insurance company's perspective.

MR. KING: I have never agreed that the linear formula is the only way of expressing risk. In fact, when you brought it up I suggested there was only one way.

MR. D. POCH: Q. Mr. King, I guess I am asking you this, you, like most people, do in fact in your every day dealings, for example, with the purchase of insurance, do treat high consequence risks differently than you do treat manageable consequences.

MR. KING: A. Yes. In some cases very high consequence events you forget about them completely. There are certain exclusions in life insurance policies. I don't go out to buy in insurance to cover those exclusions, or try to get insurance from

somewhere else.

Q. It may not be available, it may not be affordable. It may not be worth it to you.

Mr. King, the point is, isn't it, that it is not unscientific of you, it is just not a matter of perception that you buy insurance. It may be rationale in the circumstances to treat the high consequence risk which has a similar risk expectation value as low consequence risk but to treat it differently. You are not disagreeing with that, I take it.

A. In some circumstances it may be appropriate to treat it differently.

Q. Can you understand why some might find a nuclear meltdown an unacceptable consequence, even if of very low probability, if there are good alternatives available at similar cost?

A. You have to look at the levels of risk and that risk expressed in several ways, not just as the product of probability and consequence, but what are the sizes of those consequences. You have to look at the alternatives. If you look an alternative and it has a different risk profile, perhaps the consequences of low probability events in that other alternative are lower but at the higher frequency end there are many more consequences, and society has to do a balancing of

do you want to accept those consequences every day or do you want to take some risk of having higher consequence events at a much lower frequency.

Q. Mr. King, you would understand that some might be prepared to pay a higher premium, as it were, for options such as conservation that avoid even a slight probability of extremely severe consequences. That's consistent with the purchase of insurance, for example.

A. I assume whatever other options are out there, one has to do a complete analysis of all the implications of that option and look at both low probability and high probability consequences, and beyond that general statements I can't make any other comment.

Q. All right. Let's go on to look at how Hydro deals with the possibility of high consequence events.

You have you have evacuation plans?

A. The province, as I said in my direct evidence, is the body which controls emergency preparedness. We have a part in it, but the plans, the evacuation plans are in fact the Province's plans.

Q. And is there a licencing condition that you have to have significant emergency response

capability?

A. I am sure there is. I am not sure I could point to it right now.

Q. That is fine.

A. I am sure we wouldn't be able to operate our stations if we didn't have a plan in place.

Q. So there is an acknowledge that whatever the probability may be, there is the possibility of accidents on a catastrophic scale, hence the need for evacuation plans?

A. It's one step more in the whole defence indepth scenario. You try everything you can do to prevent accidents, but then you say, well, if they can, well, let's be prepared.

Q. And indeed the assumption is there can be such accidents.

A. That's the assumption that's part of the defence indepth. You forget about everything that's come before you with respect to trying to avoid a circumstance.

Q. What radius does your evacuation plan cover?

A. The area around each station is subdivided into sectors and I believe it goes out to 10 kilometres.

Q. We have actually plotted it on a map for you at page 159 of our materials. We have plotted some other radii too.

Are you familiar with what the primary evacuation zone was around Chernobyl?

A. The zone that was actually evacuated?

Q. Yes.

A. Perhaps Dr. Whillans can help me out here, but I believe it was in the neighborhood of 30 kilometres.

DR. WHILLANS: A. Well, the initial evacuation was of specific towns--

Q. Yes.

A. --well within the 30 kilometres. After the levels of activity on the ground were known, a 30 kilometre area was eventually evacuated, yes.

Q. We have plotted that as the larger circle on this map as well.

Would you agree with me that 30 kilometres from Pickering would get about almost exactly to this hearing room, Mr. King?

MR. KING: A. Well, I assume you have done it correctly.

Q. It would take in roughly half of Toronto?

A. Well, you have got the map here.

DR. WHILLANS: A. I think we are using the term evacuation in two different ways.

As I pointed out, the initial evacuation from the nearby towns was much within 30 kilometres, and the primarily purpose is to avoid a plume dose which is I think the main basis for evacuation here.

In the later phases after you know activity on the ground, you can make any adjustment you like.

Q. And indeed in the case of Chernobyl they went to 30 kilometres?

A. That's right.

Q. Has anybody at Hydro costed what the social cost would be of evacuating half of Toronto?

MR. KING: A. No, it's not in our emergency plans. It's not in the province's emergency plans. The provinces are well aware of what is happening around the world and there is no suggestion that the sort of consequences that occurred at Chernobyl are possible at Pickering.

Q. Have you costed what evacuating the 10 kilometre zone would be?

DR. WHILLANS: A. As Mr. King points out, this is a provincial plan. It may well be the

province has calculated that.

MR. KING: A. They are some costs calculated in some of our consequence codes, but I think that is still work in progress right now.

But the constituents are just disruption costs as well as decontamination costs and food interdiction and various components to that. But as of yet we haven't published the results of any studies showing those costs.

Q. Mr. King, we have plotted on here the 20 kilometre radius around Point Lepreau. Are you familiar with that?

A. I have been to the station.

Q. And you are aware that they have a 20 kilometre radius?

A. I was not aware of that.

What are you looking at right now?

Q. Just on our map.

A. I see. Okay.

Q. And, indeed, I will come to a reference for that in a moment.

A. Lepreau is in a very remote area.

Q. Wouldn't you agree that if you have more people close to the plant it's even more important to evacuate?

A. Well, I think if you have less people, you are less concerned with the disruption to people that may be caused in the whole emergency planning process.

There is no doubt it's more expensive to plan for larger numbers of evacuees because in our plans out to 10 kilometres we have to have relocation centres for those people in the plan, how are they going to get moved out, et cetera, et cetera.

Q. Mr. King, if you could turn to page 160, we have reproduced here the action guide at page 160 and 161 that's distributed to people around Point Lepreau, and it includes on it, it's Xeroxed there, a bottle which I understand is plastic-sealed.

I have here it. It includes on it, as you will see in the exhibit, a plastic-sealed bottle of something called Thyro-Block, which is potassium iodide?

A. Yes.

Q. Potassium Iodide is used to block radioactive iodine uptake immediately after an accident to the thyroid?

A. It doesn't have to be taken immediately, but some short time thereafter.

Q. Before of the iodine gets to the

person.

A. We are getting into Dr. Whillans' area, but there are certain time frames when you can take it, and it is effective. Perhaps he may want to comment.

Q. Dr. Whillans, can you help us there?

DR. WHILLANS: A. I am just looking at a reference by Dr. Johnson on radio-iodine dosimetry, and he has a graph which shows that stable iodine taken out to about four hours after the accident is 50 per cent effective in blocking the dose. And this is because the iodine takes sometime to get the to thyroid after it has been taken into the body.

Q. Is it more effective if you take it earlier than that?

A. Oh, yes.

Q. And does Ontario Hydro in fact distribute these bottles into everybody's home? Are they in people's home around Pickering right now?

MR. KING: A. No, they are not.

DR. WHILLANS: A. This a provincial decision.

MR. KING: A. The provincial plan doesn't require that.

Q. You haven't voluntarily distributed

them to homes in the area --

A. It's the provincial plan which controls that.

Q. You are not constrained from doing that, are you, Mr. King?

A. The pills right now are predistributed to hospitals, schools, and daycare centres in the vicinity. The remaining 500,000 pills which Hydro has are at the relocation centres at York University and the CNE for Pickering.

Q. So it may be several hours before people could actually get these pills if they were instructed to take them?

A. One of the considerations is that the release from the accident isn't an immediate event. There is an accident that takes time to progress. And in that time to progress before there is any release, then that's the time then any evacuation would occur.

Q. And Mr. King, wouldn't you agree that it is likely that you wouldn't sound the alarm and evacuate the area immediately either. You would wait to see if there is likely to be a release.

A. The most likely situation is that there are several hours -- once the emergency plan, the preparedness organization is put in place, there is

likely several hours before there would be any accident-related releases from the station.

Q. Why wouldn't you predistribute the pills?

A. That discussion has been going on for several years. There have been groups of medical doctors studying that, the province has a technical subcommittee composed of medical officer for Toronto and another doctor studying that to get the reason for why they haven't made it a requirement. I am afraid you will have to ask the province.

[11:18 a.m.]

DR. WHILLANS: A. One of the reasons is probably that those pills have a finite shelf life of only a few years, so you might get yourself into a situation where people have pills that may or may not still be effective.

MR. D. POCH: Mr. Chairman, perhaps we should just note page 160, 161 and 162, which is a letter related thereto, as exhibits from Point Lepreau emergency response?

THE CHAIRMAN: You want an exhibit number for that?

MR. D. POCH: Yes, Mr. Chairman.

THE CHAIRMAN: The number?

THE REGISTRAR: 634.

MR. D. POCH: Page 160 to 162.

(Exhibit No. 634: See page 24051)

MR. KING: What I should also mention, Mr. Poch, is that there are --

The province is contemplating changes to the emergency plan, their emergency plan, and I believe these proposed changes are at Cabinet committee level at this time.

MR. D. POCH: Q. I'm sorry, where is that? In Ontario?

MR. KING: A. Yes.

Q. All right.

A. And I believe subjects like KI pill distribution, alarms and a number of other subjects are treated in this proposed changes to the plan.

Q. All right.

A. What they are I don't know, but I know I have been told that those subjects are covered.

MR. D. POCH: Mr. Chairman, I just note for the record at page 162 there is a letter from Mr. Thompson I'm sorry, to Mr. Thompson from Mr. Dallison, the planning officer with New Brunswick Emergency Measures Organization, in which the 20 kilometre figure is provided and which simply recites the fact that

there has not been any problem with the predistribution.

MR. B. CAMPBELL: I'm sorry, the 20 kilometre figure before that you spoke of, Mr. Poch, was in relation to evacuation. I don't see that dealt with here.

MR. D. POCH: You are absolutely right, Mr. Campbell.

Q. Gentlemen, anybody on the panel that can confirm that in fact the evacuation zone is the same as the potassium iodide distribution zone, 20 kilometres?

MR. KING: A. I have no knowledge of that.

MR. D. POCH: All right. Perhaps we should just note then for the record that we are certain that the 20 kilometres is for the potassium iodide contribution and we are not certain what the evacuation zone is.

MR. PENN: I think there is a number of things, Mr. Poch, that you have inferred in your cross-examination that gives an impression that is entirely false.

The emergency plan is exercised at each of the stations every year involving the Solicitor

General's office, involving the media, involving the police, involving the hospitals, involving the Ministry of Transportation.

MR. D. POCH: Q. You don't evacuate the public every --

MR. PENN: A. No, but we have observers to ensure that we can learn from any part of the process which is exercised. That is one thing.

The other thing is that if there was any decision to evacuate it is my understanding that it would be made as a result of the recommendation from the Solicitor General to the Premier of the province, and so it is not an issue that is taken lightly. It is an issue that is taken very seriously.

I think it is unfortunate that in your cross-examination you leave unsaid things that have clearly been looked at in great detail and very seriously in the past.

Q. Mr. Penn, I don't think it is my responsibility as a cross-examiner to put all the evidence out. I am really just trying to elaborate or elicit further answers from Ontario Hydro about what the nature of risk and risk management is.

A. Well, I just wanted to put on the record--

Q. That's fine, Mr. Penn.

A. --a little bit of balance, in it.

Q. That's fine, Mr. Penn.

MR. KING: A. Just because you only have a zone of whatever distance, 20 or 10 kilometres, doesn't mean that you can't evacuate more than that.

What it means is that that is the hardest evacuation to do, it is the closest, and it is the one which has the highest priority. It doesn't mean that you can't extend that just like what happened at the train derailment in Mississauga where they started with a small area and then went larger and larger.

Q. Mr. King, have you studied the logistics of evacuating half of the City of Toronto?

A. I have just made a general statement. No, we have not, but just because you have developed a plan to go a certain distance it doesn't mean that you have then no capability to go beyond that distance.

Q. I understand your point, but, Mr. King, you would certainly agree that the logistics, the time involved, the costs of evacuating half of Toronto are not an insignificant matter?

A. The are certainly not. They are not insignificant.

Q. All right. Okay. I would like to go

on and talk about waste. I understand that there are plans for low level waste, there are new plans afoot for the low level waste facility at Bruce that shortly will be presented to the AECB; is that correct?

MR. JOHANSEN: A. The Bruce radioactive waste management site is continuing to be expanded as required as the nuclear system grows. It has continued expansion since its inception, and there are a number of facilities that are being considered and would be the subject of an application for further approval from the AECB. That's right.

Q. You haven't presented to this Board what your considerations are in that regard or your assessment of them; that is going on before the AECB?

A. There was an interrogatory, I believe, on that question.

Q. You haven't presented an environmental assessment of your low level waste operation, or your future low level waste operations here?

A. Not here, no.

Q. And with respect to the pressure tubes that were removed from Pickering, I understand they are in concrete casks?

A. That's correct.

Q. And is that considered intermediate level waste or high level waste?

A. That would be categorized as a Level 3 or intermediate level waste.

Q. And what are your plans for it?

A. Well, as I indicated in my direct evidence, it will remain at the reactor site at Pickering in the case you referred to until the plant is eventually decommissioned and the retubing wastes and other wastes of that sort from rehabilitation of reactors would be disposed of, together with the other decommissioning wastes.

Q. Is it your intention to dispose of those pressure tubes in the deep geological facility you envisage?

A. That is not part of the present plan within the Nuclear Fuel Waste Management program. There is currently at Ontario Hydro an effort under way to update the long-term management and ultimate disposal of low and intermediate level waste, and it is within the scope of that program that the retubing was would eventually be managed.

Q. So it is an ongoing discussion? You have no specific plans at this time?

A. There is a plan, but it is not up to

date. It is just now being updated.

Q. And do you have a license to store this waste we just spoke of on site at Pickering?

A. The retubing waste?

Q. Yes.

A. It is covered by an interim approval--

Q. All right.

A. --under the existing station license.

Q. All right. Now, with respect to the disappeared fuel bundle, how much waste would be associated with that fuel bundle?

A. You are talking about wastes produced at our station or --

Q. Radioactive wastes in general.

A. Altogether. Well, I believe in your own document, Exhibit 525, you have calculated what the tailings volume would be associated with the fuel bundle, and I believe in calculating that you use a unit value that we published or included in our environmental analysis report, Exhibit 4.

I believe you have computed that a fuel bundle would require something like 12 metric tonnes of tailings, and in my direct evidence I indicated that in a typical year Ontario Hydro produces something like

7,000 cubic metres of various low and intermediate level wastes.

I also presented in my direct evidence information on the amount of fuel that Ontario Hydro has consumed to date and forecasts to use in the future, so one could calculate what on average the amount of total wastes from beginning of the fuel cycle to the end would be associated with the use of one fuel bundle. But I don't have that number in my head.

Q. I'm sorry, I was distracted. Did you give us a reference to where we could find the wastes associated with the various refining and fabrication stages?

A. I believe there is information in our materials report; that is, Exhibit 507.

Q. All right.

A. And the unit values that I referred to in terms of so many terawatthours of electricity generated are presented in Exhibit 4.

Q. All right.

A. I believe that was the source for the sort of calculations that were presented by your client in Exhibit 525.

Q. Yes, that's correct.

Mr. Chairman, that is a convenient place

to break.

THE CHAIRMAN: All right. We will break for 15 minutes.

THE REGISTRAR: Please come to order. This hearing will recess for 15 minutes.

---Recess at 11:30 a.m.

---On resuming at 11:56.

THE REGISTRAR: This hearing is again in session. Be seated, please.

THE CHAIRMAN: Mr. Shepherd?

MR. SHEPHERD: Mr. Chairman, forgive my funny talking. I spent the morning at the dentist. I am still all frozen.

I thank you for your indulgence and the cooperation of Mr. Poch in filing on the record a motion jointly sponsored by IPPSO and the group with us, the Canadian Wind Energy Association, by the Coalition of Environmental Groups and the nine groups within that coalition, and by the North Shore Tribal Council together with United Chiefs and Councils of Manitoulin, Union of Ontario Indians, and White Fish River First Nation.

Obviously, I am not going to speak to the motion. I wanted to put it on the record, however, so that the parties would see it in the record rather than

hearing it from the press since there seems to be a bit of press interest in it, and to point out to the parties on the record this is returnable at a date to be determined by the Board after the proponent's case in chief.

It is a motion in essence asking you to accelerate your decision with respect to approval of the Manitoba transmission. We will of course argue denial of that approval.

The only other comment I would make is that although this has some aspects of a nonsuit its intention is not to be a nonsuit in the normal sense. It relies instead on the special circumstances of the cancellation payments and other costs associated with the Manitoba Purchase.

I have copies of the motion here for parties who wish it, and I think that is all I should say.

Thank you for your indulgence.

THE CHAIRMAN: Thank you, Mr. Shepherd.

Mr. Campbell?

MR. B. CAMPBELL: Mr. Chairman, I was provided with a copy of the Notice of Motion on reentering after the break today.

During the course of the break, however,

my friend says the media seems to have got wind of this in some surprise.

I would like to advise the Board that my client was contacted by major media prior to the start of the hearing this morning and I have been provided with a press release issued on IPPSO letterhead to major media before the start of the hearing this morning in which arguments in support of what I take will be in support of this motion are made in the media, including the statement that Ontario Hydro finished presenting its evidence in support of the transmission, that being the transmission for the Manitoba Purchase, on January 23rd, and that evidence was seriously undermined by damaging revelations from Manitoba Hydro on the economics of the deal.

There are a variety of other statements contained within the press release which deal with matters that are under active consideration of the Board.

I focus on that one simply because I take it as an example of misleading and inaccurate information. Our case with respect to all of the approvals that we are seeking, including Manitoba transmission, is not complete.

Now, this is not first time in these

proceedings that concerns have been raised as to inappropriate use of the media. I can advise the Board that on the argument of the MEA application before the Divisional Court one of the comments made by the Divisional Court, in particular Mr. Justice Carruthers, with respect to the behaviour of parties who are involved in proceedings of this type was that Energy Probe's use of the media with respect to matters that were the subject matter of that motion was -- and I think this is a direct quote although there is no transcript of course of those proceedings so I have to caution that.

Mr. Justice Carruthers reminded counsel for Energy Probe arguing that motion that in the view of the Panel the use of the media in the way that had been done there was 'most irresponsible', and reminded counsel for Energy Probe that when matters are before courts, boards, tribunals, that it is inappropriate to use the media to argue the case, and, in my submission, I believe it would be helpful to the ongoing fairness expected of these proceedings if the Board were to reinforce that principle.

THE CHAIRMAN: Are you asking us to do anything at this particular point?

MR. B. CAMPBELL: Yes, Mr. Chairman. I

am asking you to remind the parties of the obligations that they have and the expectations that they have and their counsel have with respect to arguing their case in the media as opposed to arguing it in front of this Panel.

Clearly, the press release which was issued many hours before we had any knowledge at all of the Notice of Motion rather than having the media somehow miraculously take an interest in this matter was designed to incite media interest in this matter, and my friend Mr. Shepherd is both quoted in the news release and is identified in the news release as a contact person with respect to this matter should further information be required.

Now, in a matter as important as this all I am asking is that the Board be cognizant of and perhaps encourage the parties to be cognizant of the general principles which I take as associated with good practice before courts and tribunals as to arguing one's case in the media.

MR. D. POCH: Mr. Chairman, if it is your intention to speak to that or to issue any comment on that I would ask for the opportunity at some point to put in submissions first if it is indeed the Panel's intention to make any comment.

I think you may be aware a related issue has come up before other environmental assessment panels. There has been lengthy considerations on what is the appropriate role, especially of counsel for public interest groups, and I would ask simply if it is your intention to offer any direction that we have an opportunity to present that and other information to you first.

THE CHAIRMAN: Well, Mr. Campbell has specifically asked us to make a direction so we either have to do that or not do that, so if you have anything you want to say about that I guess you should.

MR. D. POCH: Mr. Chairman, I don't have that material with me today. I am not prepared to speak to it today, but perhaps if Mr. Campbell is seeking a direction from the Board then the appropriate method would be for him to file a motion, and so we could respond formally.

It is, as you can appreciate, a very sensitive issue in terms of our responsibilities to our clients in terms of questions of freedom of expression, and so on.

THE CHAIRMAN: I'm told by Ms. Patterson that this issue came up at another hearing of this Board, the Timber Management, and it was dealt with and

there was a ruling made by the Panel in that Board.

MR. B. CAMPBELL: That is quite correct.

MR. D. POCH: That was my oblique reference, Mr. Chairman.

MR. B. CAMPBELL: That is quite correct. We appear as counsel for the Ministry of the Environment in that matter, and in making the comments that I make -- or my firm appears as counsel for the Ministry of the Environment in that matter, and in making the comments I am fully cognizant of that ruling.

[12:05 p.m.]

I take particular exception, Mr. Chairman, however, to what clearly must have been reviewed by counsel by way of a press release going out far in advance of us being served with any Notice of Motion and one which is clearly undeniably, irrefutably factually incorrect with respect to the conclusion as to all evidence having been heard on this matter. That is simply not true. No one has been following these proceedings could possibly think it was true, not having heard Panel 10 evidence.

THE CHAIRMAN: Maybe it's too simple to say that whatever is said in the press about any issue before this tribunal has no effect whatsoever on how we

deal with the issues that come before us.

One expects the press to behave responsibly and within the general requirements of the practice between the courts and the press which they generally seem to do.

I don't know what more can really be said at this time, but perhaps if this is an issue that Hydro wishes to have pursued, then we perhaps should hear submissions on it.

MR. B. CAMPBELL: Mr. Chairman, in my submission, the obligation that I am concerned about is not what happens in the press, it's the obligation of counsel who are appearing before you and who take these kinds of steps, it's their obligation to be factual and correct.

THE CHAIRMAN: But do you want us to lecture them to do that?

The situation of Energy Probe, and I hesitate to comment on it because we are all at the disadvantage in not have a having the material, but it wasn't exactly the same kind of an issue that Mr. Justice Carruthers was addressing, it was analogous but not identical, as I understand what the issue was before the Divisional Court.

MR. B. CAMPBELL: I don't want to get

into a comparison of the two, and I am quite happy to.

I think it is germane. I think we have an example here where Ontario Hydro, my client, all of a sudden started to receive a flurry of telephone calls in relation to a matter that the press believed was happening in this hearing. Ontario Hydro had absolutely no knowledge of it, and when it reviewed the material that had been forwarded by the media it is clear that there are elements of it that are completely and utterly false and they have obviously been reviewed by counsel. And in my submission, whatever counsel do in this area, the Board should, in my submission, ensure or make clear that it expects counsel as a minimum to be in this kind of situation to at least be accurate in their description of the state of the proceedings. And in my submission there is a general principle that has been widely recognized, that for counsel to argue their case in the media is simply inappropriate.

---Off the record discussion.

THE CHAIRMAN: Mr. Shepherd?

MR. SHEPHERD: Mr. Chairman, I don't want to make a big deal out of this, however, Mr. Campbell has challenged my propriety and integrity and he is out of line.

What he said to you is several hours before I came to this Board I issued a press release. That's not true.

MR. B. CAMPBELL: I am sorry, Mr. Chairman, if we are going to argue this, that is not what I said.

MR. SHEPHERD: Mr. Chairman, I didn't interrupt Mr. Campbell, I don't expect to be interrupted.

MR. B. CAMPBELL: If you are going to be giving argument on the basis of what I said, say it right. I said before I was given this notice. I have no idea who Mr. Shepherd talked to when. I said before I saw it.

MR. SHEPHERD: As I was saying, what in fact happened is at approximately 9:30 to meet press deadlines my client - not me - my client issued a press release. I am happy to provide the Board with a copy of that press release so that the Board can determine for itself whether there was any impropriety in that.

I am quoted late in the press release on the legal question why the motion is being filed, not on the substance of the motion.

I am listed as a contact person because that's what you do when you quote somebody.

I did not take my client's position. I would not do that.

The reason why this was not tabled at ten o'clock is because I was in a dentist's chair.

And finally, and the most important thing, I personally told Mr. Campbell we were going to do this in February.

I have no further submissions.

THE CHAIRMAN: Well now, this seems to be getting to be a mountain out of a mole hill.

Thank you, Mr. Shepherd.

Certainly, and the genie being out of the bottle, that is the press realize having been made, there is no remedial action that can taken about that in any event.

I would agree with Mr. Campbell to this extent, parties should be scrupulous about the way they deal with the press. I haven't read the press release and I probably don't intend to read the press release. I have been involved in proceedings, many, many proceedings which have had a lot of press attention and my general practice is not to read what is in the press.

But parties should understand their responsibilities and I hope that they will have done

so, and should continue to do so.

I don't think we should pursue this particular incident any further.

MR. D. POCH: Thank you, Mr. Chairman. A little housekeeping, if I may.

First of all I think I have been remiss in not pointing out that today is the both the anniversary of the commencement of sittings and is Earth Day.

THE CHAIRMAN: We were wondering whether anyone was going to mention that.

MR. D. POCH: Perhaps on a lighter note, I have give my regards to all on Earth Day, and let's hope for not many more anniversaries of sittings.

The other matter, Mr. Chairman, I promise to try to seek out information with respect to an exhibit that was filed yesterday which was the AECB staff memo to its board requesting funding. I don't have any information yet as to if the board made a decision on that, but I do have, and I will provide copies, the proposed agenda for board meeting of April 2nd, 1992, from the Atomic Energy Control Board which lists as item 12.2 the particular report that we filed.

So that does assist in putting a date on the matter. It was intended to be put before the

Atomic Energy Control Board, and if we get further information I will make that available to you.

Mr. Chairman, perhaps I could get this an exhibit number and we will provide copies.

THE CHAIRMAN: All right.

THE REGISTRAR: 635.

---EXHIBIT NO. 635: Proposed agenda for board meeting of April 2nd, 1992, from the Atomic Energy Control Board.

MR. D. POCH: Finally, Mr. Chairman. I did earlier in my cross this morning refer to the Point Lepreau evacuation kit, there was a Xerox of the kit. I have one actual kit and I think it would be appropriate to leave this as an exhibit in its entirety as well.

THE CHAIRMAN: All right. 636.

THE REGISTRAR: 636.

---EXHIBIT NO. 634: Point Lepreau Action Guide (pages 160-162 of Exhibit 577) and package containing Emergency Response Guide.

MR. D. POCH: Q. Mr. Johansen, if you could turn with me in Exhibit 507, I wanted to touch on the question, while we are discussing waste, on the question of tailings.

THE CHAIRMAN: Just one moment.

I think we gave the pages 160 to 162 in your book an exhibit number, and that, in effect, is

what you have just filed.

MR. D. POCH: Yes, Mr. Chairman, that was 634.

THE CHAIRMAN: So that last Exhibit No. which is given as 636 should probably be marked as 634.

MR. D. POCH: That is fine. That would be the kit, the full kit should also bear the number No. 634.

THE REGISTRAR: Then I will just negate the 636 and it is still vacant.

THE CHAIRMAN: That's right.

MR. D. POCH: Thank you, Mr. Chairman.

Q. Returning to the tailings aspect of waste. Mr. Johansen, I take it that you are the witness who is most familiar with this issue?

MR. JOHANSEN: A. With the subject of waste management?

Q. Yes.

A. I know something about it.

Q. At page 515 of Exhibit 507 there is a commencement of a discussion on public hazards which is a subsection under radiological impacts, I note, and there is a listing of the sources of potential radiological exposure of the public from mining and milling operations. And if we go to near the bottom of

that section, which is at the top of page 516, you note:

> The radon flux density can vary by more than a factor of 10 to the 6th - which is a million - depending on the treatment assumed for the future management. For example, the Ontario Hydro DSP environmental analysis lists potential mitigation as disposal at mine sites with underwater containment and a 2 kilometre buffer zone, and the airborne radon source would then essentially be zero.

Following on, this is again on page 516 of Exhibit 507, and the bottom paragraph you note that:

> The characteristics of uranium mine mill sites to be associated with the future uranium sites are not known at present.

Mr. Johansen, we do know something about the existing sites, do we not?

A. Yes.

Q. And they are not as yet being treated in the manner suggested there as a possible mitigation strategy?

A. I assume you are referring to the tailings?

Q. In the Elliot Lake area, for example.

A. Connected with Ontario Hydro fuel?

Q. Yes.

A. Certainly those mining operations supply uranium concentrate to many other users, in fact a great majority of it goes to other users, some 80 per cent I would think.

Q. Mr. Johansen, could you turn to page 163 of our first volume of materials. There you will see a photo which is of one of the Elliot Lake tailings piles. I have got a blow-up here for convenience of the panel.

I think it is appropriate to point out that the woman in the foreground is counsel for the North Shore Tribal Council, Ms. Marlatt. I promised to make her famous.

Mr. Johansen, have you had an opportunity to visit those sites?

A. Not for a long time. I have been by the area a number of times. I come from Alberta, so I make that trip occasionally.

THE CHAIRMAN: I don't know if you are going to call Ms. Marlatt, but can you give us some

idea when the photograph was taken?

MR. D. POCH: I didn't think that would be necessary. This was taken approximately one year ago at the Stanley site just north of Elliot Lake.

Q. Mr. Johansen, are you familiar if there is anything stopping those tailings from washing or blowing away?

MR. JOHANSEN: A. The active areas of the tailings management areas are, I understand it, not covered.

Q. Not covered, that is nothing has been spread over this to try to contain it?

A. That's my general understanding, yes.

Q. Just so we can help the panel understand what this is. We are looking at the leading edge, if you will, of what is, in essence, a lake or a pond, if I may draw the analogy, of a fine white granular sort of texture of fine sand material which is the tailings slurry that comes out of the mill; is that correct?

A. Well, I assume that's what it shows.

Q. That's consistent with your understanding of what a tailings pile looks like?

A. Yes.

Q. It's a fine granular material?

A. Yes.

Q. All right. And is there a plan in fact to do something about this?

A. Well, it's not an area that Ontario Hydro has a large involvement in, except as we have indicated in response to, I believe it was one of your interrogatories, which I think I would like to refer to. Yes, Interrogatory 9.7.71, it was a question from your client asking about --

THE REGISTRAR: That was given the number .95. Beg your pardon, 9.7.75.

MR. JOHANSEN: It asked amongst other things about whether the cost of uranium included some provision for decommissioning of these wastes, and our response indicated that Ontario Hydro had no financial involvement in the decommissioning of these wastes except in the case of the Stanley Mine, which was dedicated to Ontario Hydro's supply.

MR. D. POCH: Perhaps, Mr. Chairman, it's appropriate to mark this photo of that tailings pile as an exhibit then.

THE REGISTRAR: With respect, 9.7.71, should that be given a number? I said it was entered but it is not.

THE CHAIRMAN: Then it should be then.

THE REGISTRAR: It is .115.

---EXHIBIT NO. 520.115: Interrogatory No. 9.7.71.

THE CHAIRMAN: And we need now an exhibit number for the photograph.

THE REGISTRAR: That will be 636.

MR. D. POCH: Thank you.

MR. B. CAMPBELL: Mr. Chairman, there are a variety of mine sites in the Elliot Lake area. Clearly the witness has not been able to confirm that this particular picture is associated with the Stanley Mine. I have no way of knowing one way or the other. I don't argue with my friend with.

I would like the opportunity before it's recorded as being associated with any mine, I don't really care, but before it is recorded as being associated with any particular mine, I think it would be fair if we at least had the opportunity to have some discussion with my friends as to where and when and so on the photograph was taken.

MR. D. POCH: Mr. Chairman, perhaps we should just note that it's mine tailings in Elliot Lake vicinity.

I have another photograph taken with this one that actually has the sign plaque and I will search out that photo so that we can, with some certainty,

identify this for you.

I take it, Mr. Campbell, you are just uncertain about which site?

MR. B. CAMPBELL: We have no basis on which to place this at all, and I think just out of a small nod towards appropriate practice, I should at least satisfy myself on that.

MR. D. POCH: Well, I am sure we will be leading a witness, Mr. Chairman, as will Northwatch, who is in a position to identify this photo and others, and perhaps then we should just leave this identified as a photo of a tailings pile. I think Mr. Johansen's evidence indicates it's consistent with his understanding of what have it looks like, and this or some similar photos will be identified later as to their particular location by someone who has toured these sites, if that's acceptable Mr. Campbell.

MR. B. CAMPBELL: That is fine. And I may be able to come back and say, fine, we agree that that's associated with the Stanley Mine. I hate getting something labelled an exhibit before I have even had and opportunity to do that.

---EXHIBIT NO. 636: Photograph of a tailings pile.

[12:25 p.m.]

MR. D. POCH: Mr. Chairman, I am content

and nothing turns on which particular site it is for my purposes.

Q. Mr. Johansen, I take it from your response or your reference to Exhibit 520.115 you are not familiar with what the plans are then for tailings management for the various sites?

MR. JOHANSEN: A. Well, all I know is, to answer your question, I am not familiar with the specifics. I only know that they are the subject of ongoing discussions between the mining companies, and the AECB, and other government and regulatory agencies, the Ministry of the Environment in particular, I guess.

But this isn't an area that we have any technical responsibility for, except to the extent I indicated there are some provisions for at least sharing some of the cost of decommissioning the standing mine --

Q. Do you have any estimate of what it will cost to remediate these sites?

A. No specific estimates for these particular sites. The only knowledge I have is of a general nature obtained from conferences, papers, and so on, and all I can say is that the costs are obviously not insignificant but I would say that the costs are not, for example, compared to the cost

estimates being assessed for the high level used fuel program, they do not appear to be prohibitive.

But I really think I should stop at that point because it is not based on any site-specific assessment that I have been involved in, but only generalized.

Q. Mr. Johansen, you would agree the distinction between this and high level waste is the high level waste cost stream is to a large extent into the future and if we are comparing options the discounting effect has a much greater influence there than it would if we were going to face remediation costs for these existing sites in the nearer future?

A. Well, that is Mr. Penn's bailiwick, I guess, but I believe I can say that that is probably a fair statement.

Q. All right. Now, high level waste has been identified by the public as a key concern with nuclear power; is that fair, Mr. Johansen?

A. Oh, yes. I think that is a fair statement, yes.

Q. It has been the subject of several reports over the years in Canada?

A. Certainly.

Q. And could you turn to page 164 of our

materials?

Mr. Chairman, this and through to page 170 is an excerpt from a report entitled: The Management of Canada's Nuclear Waste, chaired by F.K. Hare. It is a federal report that dates from August, 1977.

Perhaps it should get a separate number.

THE CHAIRMAN: Next exhibit number?

THE REGISTRAR: 637.

---EXHIBIT NO. 637: Report entitled: The Management of Canada's Nuclear Waste, chaired by F.K. Hare, a federal report dating from August, 1977.

MR. D. POCH: Q. Now, Mr. Johansen, are you familiar at all with this effort?

MR. JOHANSEN: A. Yes, I am. In fact, I would call it the founding study or report upon which the present Nuclear Fuel Waste Management Program in this country is based. It was the study which recommended the development of a geologic disposal concept to be -- that is focusing on the Canadian Shield in this country, and in particular the Ontario portion of the Canadian Shield, for reasons that are set out in the document.

So it was a very important document submitted to the Minister of Energy, Mines and

Resources Canada, who in turn was instrumental in initiating the Canadian Nuclear Fuel Waste Management Program in 1978.

Q. Is it fair to paraphrase the conclusion in this report that they saw deep geological disposal as promising and that therefore it would be appropriate to go ahead with nuclear power but that detailed studies of the risks and uncertainties were not available at that time?

A. Well, I guess there are two parts to that.

Certainly, the latter is true; there were not in 1977 detailed Canadian studies, nor conclusive studies elsewhere, that geologic disposal as a concept was safe.

There was a large judgment and optimism and scientific confidence, although I acknowledge views to the opposite, contrary as well, but there was around the world a general consensus that geologic disposal held the most promise for ultimate isolation of these materials, and--

Q. Mr. Johansen, perhaps I can help you --

A. --the first part of your question with regards to the advisability of proceeding with

future nuclear development pending the ultimate resolution of this disposal question, it is basically as you had indicated.

Q. Right. And I just direct your attention to page 170 of our materials in the discussion, highlighted a section there which states that conclusion, but adds:

> But there is great urgency in testing these conclusions.

And you are aware that this was a relatively short, a quick look as it were at the issue?

A. Well, I'm not sure exactly what you mean by a relatively quick look.

Q. Well, I just took that from page 166 of our materials where in the introduction to the report it is noted that:

> As a result, we feel that despite the very short time available to us, too short to permit detailed study of all technical aspects, we have nevertheless been able to put forward significant recommendations.

I take it that is consistent with your understanding of what the nature of this report was?

A. Yes. This was not intended to be the

definitive study on acceptability of a given concept; it was the starting point. I'm sure that the Commission would not have made conclusions, regardless of what the time schedule was at the time, would not have made conclusions without confidence in those conclusions.

Q. All right. Now, the Chair of that report that offered that fairly rosy prognosis for waste disposal and for nuclear power, that was the same Dr. Hare who chaired the ONSR?

A. That is the same Dr. Hare, yes.

Q. And again, this report didn't seek to compare options, compare nuclear with other options?

A. Certainly, no.

Q. Now, I understand shortly after Dr. Hare gave his view in this report on the waste issue, the waste issue was addressed by Dr. Porter in the Royal Commission?

A. That was one of many issues addressed by Dr. Porter, yes.

Q. Now, Dr. Porter's name has come up before, too. Would that be the same Dr. Porter that is referred to in the Energy Probe materials at page 77 of Exhibit 608 under the heading Third Party Advocates?

Among them, Dr. Arthur Porter were

encouraged to prepare news articles and features supporting the industry and stressing the benefits of nuclear power now and in the future. These were arranged on a pay-for-publication basis?

That is in a letter, the CNA letter signed by Sam Horton, who I gather is a Vice-President at Ontario Hydro? Would that be the same Dr. Porter?

A. Could you direct me to the page?

Q. Page 77 of Exhibit 608. I think I can answer the question for you because I have just looked overleaf at two pages further on where Energy Probe reproduced an article where the pro position in favour of nuclear power is put forward by an Arthur Porter, and he is described there as former Chairman of the Ontario Royal Commission of Electric Power Planning?

A. I wonder if I --

THE CHAIRMAN: Dr. Arthur Porter was the Chairman of the Royal Commission on Electrical Power Planning.

MR. JOHANSEN: Yes.

THE CHAIRMAN: Is there any --

MR. JOHANSEN: There is no disputing that.

THE CHAIRMAN: There is no dispute about that, I take it.

MR. JOHANSEN: I don't wish to contend that, but there was something about the quote, and I wonder if I could ask you for the page number.

THE CHAIRMAN: I am not sure what his involvement, if any, with another organization at a later date has that much to do with anything.

Are you trying to suggest that Dr. Porter has some kind of bias? Is that what you are trying to say?

MR. D. POCH: Mr. Chairman, what I am laying out here is that there has been a schedule suggested for what would be appropriate for the resolution of this question by a number of people who have looked at it over the years, and I am actually trying to make the opposite point; that is, that these gentlemen who were entrusted to make these decisions - and I will summarize this in a moment - and who set out appropriate schedules were not people who were in any way adverse in interest to nuclear power, and I was just trying to set the stage --

THE CHAIRMAN: But are you questioning their objectivity and bias in what they were doing? Is that what you were --

MR. D. POCH: No, Mr. Chairman. I am not doing that.

THE CHAIRMAN: All right.

MR. D. POCH: But I don't think anything turns on this --

THE CHAIRMAN: I would leave this particular area, Mr. Poch, if I were you.

MR. D. POCH: Mr. Chairman, I was trying to make a very simple point and I can see it is getting much more complicated than I intended and nothing much turns on that.

Q. Let's turn, then, to the excerpt from Dr. Porter's report which appears at page 171 of our materials, where he reports the Hare task report which we have just looked at and the Uffen report which are was another report in circulation at the time, and then offers the Commission's conclusion. And it is all nicely presented in a comparative conclusions table.

MR. JOHANSEN: A. Yes, I have that.

Q. And I am just going to refer you to his conclusion where he says in the second line under Commission's Conclusions:

> We endorse the Uffen conclusion. However, we go further and conclude that continuous monitoring of waste disposal

research should be undertaken by an independent panel of experts reporting to the AECB. This corresponds to the Uffen proposal for a Canadian nuclear waste management advisory council. If adequate progress is not being made say by 1985 the nuclear power program should be reassessed and a moratorium on additional nuclear stations should be considered.

I also draw your attention under his report with respect to the Hare task, the bottom part of the paragraph there:

Time limit on scale of nuclear program is mentioned based on progress in the development of disposal technologies.

So would you agree that both of these gentlemen who were --

A. I'm sorry, Mr. Poch. That last quote--

Q. Just the last sentence--

A. --I didn't pick up.

Q. Under the column Hare Task Report in the second grouping.

A. Oh. Okay. Right. I see it.

Q. Would you agree that the findings of,

in essence, all of these commissions that have looked at the matter is that there is some need to demonstrate and get down the road on this question on a certain time scale before a commitment to nuclear power is extended?

A. Well, that is certainly what is indicated in the report, or in this particular table, which is taken out of the interim report.

I should emphasize, however, that in the final report from the Royal Commission the deadline, if you will, is revised by some five years in the final recommendation. It says 1990.

Q. 1990.

A. I think what it indicates is that that is a target and there is some obvious recommendation here for industry to get on with it. I don't think anything particularly significant hangs on whether it is 1990 or 1985 or 1995.

Q. Don't you agree that Dr. Porter made some significant tie, whatever the date is, he significantly tied the suggestion that there ought to be a moratorium if we haven't seen progress by whatever date and no further commitment, and so if one of the questions before this Panel is whether or not there should be a further commitment to nuclear don't you

think that is relevant?

A. Well, that is what the report recommended.

Q. All right.

A. The question that one has to ask then is: What is acceptable progress?

I believe that this Porter interim report plus the Hare Report were key findings and recommendations that were used by the federal government in setting out its policy and specifically setting out the objectives and time frames and responsibilities in the Canadian Nuclear Fuel Waste Management Program.

And that then became the commitment to develop and assess and demonstrate the technology consistent with this recommendation, and I believe Dr. Porter had subsequently indicated his satisfaction that things are well under way. So I see nothing inconsistent --

Q. I'm sorry, is there a subsequent report you are referring to?

A. Not a report. I am just aware of opinions that he has expressed over time on the subject.

Q. I think you would agree with me that

Dr. Porter's findings expressed in the context of being a Royal Commissioner are quite distinct from his personal views or his views that he is being employed to present by the Canadian Nuclear Association?

A. That may be, but the fact is that the Nuclear Fuel Waste Management Program is well under way, has developed a concept, and preliminary assessment has been done and reviewed by government agencies and the Atomic Energy Control Board. So I mean, there has not been a lack of activity towards this goal.

Q. Let's just look at what Dr. Hare thought the appropriate schedule was.

At pages 167 and 168 of our material, at the bottom of 167, top of 168, he sets out -- he indicates:

> We are not the right group to determine the critical path chart, but we feel that these targets are important...

and sets out a number of dates from '78 through to the year 2000.

[12:45 p.m.]

But in the year 2000, rather than 1995 to 2000, I should say, he notes:

> Have an operating repository capable

of receiving the Canadian annual output of irradiated fuel.

You are not anywhere near that, are you?

A. No. And I would add that this sort of time line needs to be considered in the context of what the forecast of nuclear operations and fuel arisings was when this recommendation was made and what it is today. That is one point I would make.

Q. Well, it's even lower today and you don't have any repository capable of taking today's annual production.

A. I don't have a repository.

But if I could finish. The fact that we don't have a repository doesn't mean that we don't have the means presently or for many decades in the future to safely manage the material. We certainly have that. And it is for that reason that I have previously said in these proceedings that there is no urgency to rush a solution, and by that I meant that we could take the time to do it right, and that is what we are doing.

Q. Mr. Johansen, I don't want to argue that point with you. I certainly agree with you. But you would agree that there may be some urgency if someone is being asked to approve the production of more waste; isn't that fair?

A. Well, that depends on whose view you are looking at.

Q. Mr. Johansen, could I direct you to page 172 of our materials. This is a more recent look at the question of waste. I have the actual report, perhaps we could note on this, this is a January 1988 report, I am sure it's familiar to you, of the Standing Committee on Environment and Forestry on the Storage and Disposal of High Level Radioactive Waste, this is a Federal Standing Committee.

A. Yes.

Q. And are you aware that their 15th recommendation, which appears on page 173 of our materials, is that there be a moratorium on the construction of nuclear power plants in Canada imposed until the people of Canada have agreed on an acceptable solution for the disposal of high level radioactive waste. And furthermore, the Canadian energy strategy should formulate alternatives that would encourage a reduction in energy consumption and a decrease in stress on the environment from waste created by the various energy producing techniques, and I assume that applies more broadly to nuclear.

You are familiar with that recommendation, Mr. Johansen?

A. Yes, I certainly am. I am also familiar with the fact that the Minister to whom this report was submitted did not accept that recommendation.

Q. Who was that Minister, Mr. Johansen?

A. I cannot recall who it was in person at the time, but it would have been the Minister of Energy, Mines and Resources. Or, I guess in this case -- there have been a number of these standing committees that came out just about that time, this one I guess would have gone to the Ministry of Environment.

Q. And of course the federal government is, through AECL, a participant in the nuclear industry; fair?

A. Certainly.

MR. D. POCH: Perhaps before moving on, Mr. Chairman, I could get an exhibit number for that excerpt. This is pages 172 and 173 of our materials.

THE REGISTRAR: 638.

---EXHIBIT NO. 638: Document entitled: High-Level Radioactive Waste in Canada: The Eleventh Hour. (Pages 172-175 in Exhibit 577).

MR. D. POCH: Q. But it's fair to say, is it not, Mr. Johansen, that you have certainly understood for some time that the public acceptability

of the nuclear option is contingent upon public acceptability of a waste management regime and demonstration of it?

MR. JOHANSEN: A. Well, it's not based on my knowledge of the feedback from a variety of public opinion surveys conducted by Hydro routinely and by the Atomic Energy of Canada Limited, the public concern is not so specifically defined.

They are concerned in my general interpretation of all of the information that's been gathered over the years, they are concerned primarily that the material is safely managed and monitored. And it's not at all clear from the feedback or focus group discussions just exactly what the public defines as long-term storage management versus disposal.

The key, however, or the common denominator that seems to come through it all, is that there be ongoing responsibility and monitoring.

Q. Mr. Johansen, if we just get a sense of this. You have been talking about ongoing monitoring in terms of a few decades. Plutonium would be one of the longer-lived radio isotopes in your spent fuel?

A. Yes, it's a long-lived --

Q. And what is the half life of

plutonium?

A. 239, it's about 24,000 years, plus or minus.

Q. And, Dr. Whillans, commonly in scientific circles scientists use 10 half lives as an approximation for when there is sufficient decay to get to a de minimis point?

DR. WHILLANS: A. I wouldn't say it was common, no.

Q. No?

A. No. Obviously the activity has reduced by 2 to the 10 at that time. If it was a very high level to start with it would be important, if it wasn't it wouldn't be important.

Q. In any event, even one half life is significantly longer than the management plan you are speaking of; correct, Mr. Johansen?

MR. JOHANSEN: A. The management plan for storage, yes, and institutional control, yes. But the ultimate plan of course is to do something different from that.

Q. What is the time line on the process of developing and getting approved and building a high level waste repository, what is the current estimate, or in-service date?

A. I believe I outlined that in my direct evidence. I can simply say that the assumed in-service date for planning purposes at this time is the year 2025, which I suppose sounds like never never land, but for planning purposes, that is the assumption, and it's considered to be a reasonable planning assumption. However, we fully acknowledge that the achievability of that is not within our control. There are many circumstances that can intervene to both delay and accelerate that.

Q. Mr. Johansen, you would agree that there are certain uncertainties and risks associated with waste management, some of which can be better understood and some of which perhaps can never be eliminated; is that fair?

A. Perhaps you should clarify what you mean by risks. Are you talking about health risks, environmental or--

Q. Yes, both.

A. --financial?

Q. All three. I am not quantifying them, I am just...

A. Yes, certainly, there are uncertainties.

Q. Yes.

A. And therefore a need for conservative defence indepth type technology to be applied to ensure that there is no unreasonable risk being passed on to future generations.

Q. Could you just turn in Exhibit 507 to page 415.

A. Yes, I have it.

Q. In the middle paragraph on that page you indicate that estimates of the impact of used fuel transportation and disposal on workers, the public, and the natural environment are being developed at present. As part of the Canadian nuclear fuel waste management program, an environmental impact statement on the disposal concept is being prepared by AECL, the concept proponent, with the assistance from Ontario Hydro.

And then you go on to say that at that time you were anticipating to submit an EIS in 1993 for review under the federal environmental assessment review process.

So I take it you don't have an environmental assessment today of these risks and uncertainties?

A. We don't have a final assessment, no. However, as I indicated before, and I believe documentation has been provided in the interrogatory

process, there have been preliminary estimates over the years as the technology has evolved.

Q. If you just turn to page 521, the third paragraph there you say, this is under discussion of waste:

> In the long-term, exposure of the public may arise from radionuclides leached from the used fuel disposal container in the final fuel repository and transported in groundwater thus entering the biosphere through surface waters and wells. Estimates of potential doses to groups living in the area where radionuclides from the vault may enter the biosphere are being developed by AECL for the nuclear fuel waste management program. These data are not yet available. However, indications are that the calculated fatality risk to the members of the critical group will be exceedingly small and well below the acceptability criterion set by the AECB.

So first of all you can confirm for me that these data are still not available?

A. The estimates, the definitive

estimates, I guess I could call them, based on the latest or the current conceptual design are not yet completed. But this shouldn't be taken to mean that we have no idea based on earlier stages in the development of the concept.

Q. You haven't tabled for us in this hearing, for example, your definitive dose estimates for this?

A. For this current concept, no.

Q. All right. In the last part of the that paragraph it refers to the indication of the calculated fatality risk to members of the critical group.

I take it this is a distinction as we have seen before between a local and a global, for example, or local and a regional, or an individual and a total population dose commitment, this mention of critical group?

A. Yes, that is a reference to the same sort of critical group that we analyze around our nuclear plants, yes.

Q. You would agree, Mr. Johansen, in terms of the sort of total societal cost, it's not the most exposed individual, the thing that this addresses, or that your derived release limits address in the

plant context, it's the total population dose commitment that would be the measure of the total health effect burden?

A. Well, I believe that you have to satisfy both. You can't ignore one or the other.

Q. Yes. I didn't mean to belittle the concern for the fellow that lives at the fence.

MR. PENN: A. I think, Mr. Poch, we have given evidence that the hearing starting in 1993 is reviewing the technology. And I note on page 521 of Exhibit 507, it says estimates of potential doses to groups living in the area where radionuclides from the vault may enter the biosphere is not yet available, clearly it's not yet available because we haven't had the hearing on the technology yet, agreement with that, and that must come before any site is even contemplated.

Q. That's helpful, Mr. Penn. Thank you.

And finally, just referring back to the sentence that refers to the critical group. It says:

> This will be exceedingly small and well below the acceptability criterion set by the AECB.

Mr. Johansen, you would agree with me that we can have exposures below the acceptability

level, this level or your DEL or any other of your targets, and it does not equate to no exposure?

MR. JOHANSEN: A. No, there is no suggestion that there is no exposure here.

Q. Right.

A. I guess Mr. Penn has reminded me of a very important point here, which I usually am the one to point out to others that work with me, and that is the golden rule in the program, that no site selection has been carried out nor will site selection be carried out until the concept based on generic assessment of the environmental and safety impacts has been completed to the satisfaction of the decision-makers. That is not anything that you were suggesting, I suppose, but it is important to emphasize that.

MR. D. POCH: Yes.

THE CHAIRMAN: Perhaps could we stop now?

MR. D. POCH: Yes, Mr. Chairman, that is fine.

THE CHAIRMAN: How is your time?

MR. D. POCH: I am going to struggle and see if I can whittle this down and be sure to finish today.

THE CHAIRMAN: Thank you. We will adjourn until 2:30.

THE REGISTRAR: Please come to order. This hearing will adjourn until 2:30.

---Luncheon recess at 1:00 p.m.

---On resuming at 2:35 p.m.

THE REGISTRAR: Please come to order. This hearing is again in session. Please be seated.

MR. D. POCH: Mr. Chairman, I just note that Exhibit 635, which was the AECB agenda, copies have now been provided.

THE CHAIRMAN: Go ahead, Mr. Poch.

MR. D. POCH: Thank you, Mr. Chairman.

Q. Gentlemen, I would like to direct your attention to Exhibit 534, Mr. Penn, it's your presentation to the Select Committee in August of '88 on the DSP strategy. I am not even sure you need to get it out. I just want to refer to one reference on page 21 where you say, in discussing the irradiated fuel management disposal question, you say the facility will be in-service after the year 2010. I took it from your evidence earlier that we are now talking, some four years later you have revised that estimate out about 15 years to the year 2025.

This is, I guess, another area of the nuclear program where you have experienced some slippage. Have we seen slippage before on that

particular date?

MR. PENN: A. I don't think I would characterize it as slippage. It's the recognition of, first of all, need and the need is now seen to be of the order of 2025. And furthermore, the present schedule is considered to be realistic in view of the extensive public hearings that are expected to be involved in the decision to build this facility.

Q. Mr. Penn, I understand your second point. Perhaps you could explain ---

THE CHAIRMAN: I am missing something here I think. Isn't this whole timing driven by the federal process? Isn't there is a federal process that is going on, there is a hearing that's ongoing, and they have reached the point now where they are asking people to make their submissions and they have told them what they want them to make their submissions about, and then they are going to proceed and eventually they are going to come up with a technological plan and then it will be implemented, and that's now expected to take to 2025 or thereabouts. Is that not the situation?

MR. D. POCH: Mr. Chairman, first of all --

THE CHAIRMAN: Maybe I should ask Mr.

Penn that. Is that the situation?

MR. PENN: That's my understanding, Mr. Chairman. That following the hearing on the technology and assuming that that technology that's proposed by AECL is accepted, then there would be a period of at least 10 years that's related to identifying alternative sites which would then --

THE CHAIRMAN: Just to interject there.

Isn't there is a federal task force engaged now in trying to find a site, that's been working on this since about 1989?

MR. JOHANSEN: Mr. Chairman, perhaps I could respond to that. There is indeed a federal task force involved in siting; however, it's siting for a low level waste disposal facility, not the used fuel.

THE CHAIRMAN: Okay. So there would have to be then a further exercise to site for the high --

MR. JOHANSEN: Yes, indeed.

MR. PENN: Yes, there will, sir.

MR. D. POCH: Q. Mr. Penn, just to clarify then. You would expect a decision at the earliest from the Federal Environmental Assessment Review on the concept, the technical concept when?

MR. PENN: A. Well, I think Mr. Johansen's testimony, and I would have to refresh my

memory...

MR. JOHANSEN: A. I can respond to that perhaps.

Q. That is fine, Mr. Johansen.

A. On the assumption that the environmental impact statement is submitted by the later part of the 1993, which has been AECL's plan, however, I should note that that submission plan was based on an assumption that the EIS guidelines from the panel would have been received somewhat earlier, as I said earlier in testimony, those guidelines have in fact just been received.

[2:40 p.m.]

So I suppose what I am saying is that there may be some doubt about the precise date of submission.

But for sake of discussion let's say it is late 1993, and in making some reasonable assumptions about the length of time required for regulatory staff and Panel reviews of the submission and as the federal EA process usually provides time for a statement of deficiencies, if that turns out to be the case, and in turn time for the proponent, AECL, to make supplementary submissions, and then the calling of a public hearing, and the decision-making and

recommendation at the end of all that, that, it is anticipated, could lead to a decision by government by about 1995.

Q. And given the late or the later than expected provision of the guidelines from the Panel, I take it that you are now looking at '96 as more reasonable?

A. That is simply a personal--

Q. That's fine.

A. --observation, but that is possible.

MR. D. POCH: Mr. Chairman, I note your concern and I raise these questions because I think you can expect that there will be arguments from this party if not from others that it would be premature to approve any further nuclear development until we have a resolution of the waste question.

So the timing of when there may or may not be, for example, a resolution of the concept question and then siting and then demonstration we will argue is a relevant consideration for you in deciding whether it is right to make a decision here and alternatively in your thoughts on when it would be right, if you will.

Q. Now, Mr. Johansen, that date of 2025 then is on the assumption that there is an approval in

the first round of the concept?

MR. JOHANSEN: A. Yes, on or about 1995.

Q. And again, there is a possibility that the Federal Board won't approve the concept?

A. Yes. I mean, there is the possibility that they will reject it. I personally don't think that is likely, but, I mean, it is not within our control.

Q. Sure.

A. We are confident that the concept is sound and that it will be found to be acceptable, perhaps with a number of conditions, but the program will be allowed to proceed to perhaps develop and optimize a concept further beyond that.

Q. So, Mr. Johansen, it is fair then if we assume there is a concept decision in the time frame '96, perhaps delayed a year or two if there are deficiencies and further studies, if there is a decision then that is compatible with a decision on commitment to a further nuclear expansion in Ontario looking at the 2010 time frame then, given the lead times and approval times required for nuclear?

It is compatible, that is, to wait for that decision before making a commitment in Ontario?

A. Well, I am not sure about the intent

of your description of that as compatible if it implies that one is somehow contingent on the other.

Q. I am not asking for your opinion on that. Obviously, we would probably differ on that, but if it is this Board's decision, for example --

A. It is coincident, I guess, is what I meant to add.

Q. Yes. But there is no difficulty foreseen, you know, awaiting that decision before committing to another round of nuclear construction in Ontario if 2010 is the target given the lead times? That is the simple point.

A. I'm probably not the best person to talk about the lead times, but perhaps Mr. Penn could add something to that. I realize there is nothing particularly hidden or complicated about the question, but Mr. Penn is the one who provided the testimony on lead times, and I think he is the one that should answer it.

Q. Mr. Penn, I take it there is no magic to that conclusion; you would agree?

MR. PENN: A. Well, I don't think there is a relationship personally at all between lead time and whether or not the technology is approved by a certain time for the final disposal of used fuel.

Q. Mr. Penn, I am not asking you for your judgment on that question. I am simply asking for your judgment that if it was felt that it would be appropriate before making a decision on committing to nuclear expansion in Ontario that we await the decision on the concept, for example?

All I am saying is there is no conflict there because that decision is in fact expected prior to the commitment date that you have identified given the lead times, given a need date of 2010; correct?

A. Well, I think it is a theoretical supposition, and I don't think it has any value.

Q. Could you answer my question? Can you confirm my understanding nevertheless?

A. I think I gave in evidence that for a new site for a 4 by 881 megawatt station in-service around 2010 that conceptual work would start around about 1995.

Q. So if we have a new site ultimately rather than an existing site there might be a delay involved if we were to wait then of perhaps a year?

A. Well, if it was deemed that it was necessary to have the technology irrespective of what has gone elsewhere in the world on this subject and irrespective of the near 12 years of research that AECL

has done into this matter, then you are right. But I think that judgment would have to be made, whether it is necessary.

Q. Mr. Penn, the adequacy of the 12 years of research is precisely the question before the federal panel, I am suggesting if we don't want to prejudge the outcome of that. That is precisely the same question.

A. You are quite right. But the actual length of it and its nature speaks a lot for itself.

Q. Let's turn to decommissioning. Could you turn up page 174 of Exhibit 577, which is our first volume of materials.

MS. PATTERSON: What is the page, again?

MR. D. POCH: I'm sorry, 174.

MR. PENN: Yes, I have that.

MR. D. POCH: Mr. Chairman, this is an article reproduced from Nuclear Engineering International, September, 1990.

Q. Mr. Penn, do you recognize the authors as Ontario Hydro employees?

MR. PENN: A. Yes, I do.

MR. D. POCH: Perhaps this should get an exhibit then, exhibit number.

THE REGISTRAR: 639.

---EXHIBIT NO. 639: Article reproduced from Nuclear Engineering International, September, 1990. (page 174 of Exhibit 577)

MR. D. POCH: Q. Mr. Penn, this article in September, '90, refers to an alternative decommissioning plan spoken of there for the Bruce site which is to bury the reactors in the bedrock right where they sit now; is that correct?

MR. PENN: A. That is the concept, yes.

Q. Yes. Now, co-author Mr. Naqvi is the same fellow who is the supervising design engineer and whose name appears at page 176 of our Exhibit 577 on the cover page entitled: Conceptual Plan for Decommissioning Pickering, Bruce and Darlington?

A. Yes, Syed Naqvi is the supervising design engineer that has responsibility in the Nuclear Engineering Department for used fuel disposal and decommissioning of plants, yes.

MR. D. POCH: Mr. Chairman, that page I have just referred to is attachment 8 to Interrogatory 9.7.34.

THE CHAIRMAN: All right.

THE REGISTRAR: 9.7.34?

MR. D. POCH: Yes.

THE REGISTRAR: That will be .116.

---EXHIBIT NO. 520.116: Interrogatory 9.7.34.

THE CHAIRMAN: I take it this is Exhibit 639, the article. It is not the entire article; is that right?

MR. D. POCH: I believe it is the entire article.

THE CHAIRMAN: I couldn't be sure.

MR. D. POCH: Yes, Mr. Chairman. It is page 174 and 175. It is obviously not intended to be an in-depth analysis. It is just a trade publication report.

Q. Mr. Penn, the plan, that is, the current conceptual plan - that is the one for which I have included the coverage just so I could note the author - it is not to bury them on site, but it is rather to have a waiting period and then dismantle?

MR. PENN: A. Yes, it is the 30-year stop and store period followed by dismantling, as I gave in my direct evidence, using conventional means.

Q. Now, given that the alternative was submitted and published by a Hydro employee, the same Hydro below employee in the September of '90, and the conceptual plan is dated January, '91, can I assume that there is still some consideration of alternative decommissioning techniques within Hydro?

A. No. The reference method, and it is

given on your page 176--

Q. Yes?

A. --and there are other reports that detail the methods for Pickering "B", Bruce "B" and Darlington separately, the reference method is when we get to the end of the life, 40-year life of the operating phase of the plant, the fuel and heavy water would be removed, and then there would be a period of 30 years prior to decommissioning or demolishing by conventional means and subsequent movement of that active material, bearing in mind that some 97 per cent of the material is nonactive, to an off-site location assumed to be for the sake of costing purposes 1,000 kilometres away.

Q. And again, this is the same facility I spoke of earlier today with Mr. Johansen where the pressure tubes from Pickering will end up, and it is not the deep geological site that AECL is trying to get the concept approved for.

A. It might be and it might not be. The decision hasn't been made.

Q. Now, you have referred to this as the reference, but, in other words, it is the plan that you are currently assuming for purposes of costing and so on in the corporation?

A. It is the plan that the company has adopted and has submitted to the Atomic Energy Control Board as the way we are going to do the thing.

Q. That's fine.

A. The article that you referred to is a concept that we thought of and Syed Naqvi and his staff in particular as being an alternative. But in my knowledge, we have not explored it in detail.

Q. All right. And I take it since you haven't even gotten to the point of presenting an analysis of selecting the ultimate manner of disposal as opposed to the decommissioning, you don't have an analysis of the impacts of decommissioning from the waste disposal side of it at this time?

A. We have studied the volumes of material involved and how they might be moved.

Q. Is there an analysis, for example, in the Balance of Power environmental analysis, Mr. Johansen, of the impacts on the environment and on human health from the decommissioning and the disposal associated?

MR. JOHANSEN: A. Not in any site-specific manner. I believe consistent with the way other aspects of the nuclear fuel cycle were evaluated there were some evaluations of material quantities, for

example, involved per unit of energy produced, that sort of thing. But, you are correct, there was no site-specific health or environmental impact analysis.

Q. There is no environmental or health analysis at all, is there? You are just saying the volume that will be produced?

A. That's right.

Q. All right. So leaving aside site-specific.

A. However, there was some conceptual evaluation in the document which you have extracted the title page of on page 176. The conceptual plan document submitted to the AECB contains some generic analysis.

Q. All right.

MR. PENN: A. There would be a requirement, Mr. Poch -- apart from the fact that Ontario Hydro would want to do it obviously in good time, there would be a requirement at least five years before the 40-year life, and probably 10, to do a thorough environmental assessment and to have the matter reviewed.

Q. All right.

A. There is no point in doing an environmental assessment of an event that is at the

very minimum 20 years away.

Q. Okay. I want to turn --

A. I should correct myself: 20 years plus 30 years, 50 years away.

Q. Yes. I want to turn to the question of radiation risk, and I know this has been gone into in some detail so we will try not to repeat what has been said.

First of all, Mr. Johansen, there is a distinction, is there not, between radiation as a toxic in the environment and chemicals as a toxic? And I take it you would agree radiation decays, radioactive substances decay?

MR. JOHANSEN: A. Yes, and other common materials that we use and that we are exposed to do not.

Q. Do not decay as a physical, basic property?

A. Whatever toxicity they exhibit remains essentially indefinitely.

Q. But isn't it true that while radiation apart from decay, you cannot, if you will, detoxify a radioactive substance? We are down at the atomic level, and there is little you can do about it?

A. Well, you can't do it without

actually converting the material somehow--

Q. Right.

A. --such as is conceptually envisaged in transmutation and that sort of thing, but --

Q. As you would by putting radioactive substance in a reactor?

A. For example.

Q. Whereas chemical substances often can be transformed, either transformed naturally when exposed to other chemicals solvents, what have you, or sometimes on purpose they can be treated; when you have a compound you can through traditional chemical means, in some cases at least, detoxify.

A. There are some chemicals that do degrade naturally--

Q. Yes.

A. --in the environment, and there are others that don't, and it is not a trivial matter to detoxify or to treat some of these materials which we use in our everyday lives.

Q. We are certainly aware of the efforts you have made for example with respect to PCBs. Ontario Hydro I think is a leader in developing technology there; is that fair?

A. I would say we are taking it very

seriously, being a holder of a significant quantity of those materials, yes.

Q. We have asked you in a number of places to provide detailed analysis of exposures that might be expected. For example, in Exhibit 577 our materials at page 177--

A. Yes?

Q. --you indicated that:

> Radiation exposures to mine workers and the general public due to emissions from uranium mining and milling were not specifically assessed in the EA.

And you said that you only intended to evaluate and compare alternative plans in terms of emissions and other readily quantifiable factors.

[3:00 p.m.]

A. With the general assumption that goes on to say that the plans involving lower overall emissions in other quantities would be preferable, all other things being equal.

Q. I don't know if that exhibit already has a number.

Mr. Lucas? .191?

THE REGISTRAR: This will be .117.

---EXHIBIT NO. 520.117: Interrogatory No. 9.7.191.

MR. D. POCH: Q. Well, let's see if we can find some readily quantifiable factors.

MR. JOHANSEN: A. Perhaps I can just go on to add that we have supplemented our documentation, of course, in the form of Exhibit 507.

Q. Yes, indeed, I am aware of that and I wanted to compare that to some other estimates that have been made.

At page 178 of our materials is the beginning of an excerpt from BEIR 5, I know that it has already been made an exhibit, I don't offhand know the number.

MR. B. CAMPBELL: 623.

MR. D. POCH: Q. Dr. Whillans, the members of that committee as they were comprised for the BEIR 5 report appear on page 178 of our materials. I take it you would agree that this is a fairly eminent group of scientists.

DR. WHILLANS: A. I believe so.

Q. Now, BEIR provides risk estimates that we have included at page 181 of our materials for cancer mortality. This is the table where you have drawn your approximate number of, I think you agree to a 5 times 10 to the minus 2 for a 1 person sievert?

A. Well, this table covers a large

number of conditions and some of the conditions are single acute exposures, some are continuous low level exposures and so forth.

Footnote E at the bottom points out that a dose rate reduction factor has not been applied to the risk estimates for solid cancers. As you know, ICRP and many other groups recommend that some factor be applied to take that into account. So I am just saying that the numbers that we use don't follow directly from this table, although is the summary of the basic data.

Q. Your number that you offered, that is 5 times 10 to the minus 2 is approximately half --

A. That's the ICRP number. And that's also for a complete age distribution. The worker distribution is a slightly different number.

Q. Yes. And it is approximately half of the numbers that BEIR 5 presents?

A. Yes. The recommended factor is 2 for solid cancers and it's included in the modelling for leukaemia so it's not quite.

Q. Just so we can get an understanding of how that relates to the genetic disorders that they speak of. Page 180 of our materials, in their table 2-5, you would agree that this committee, being BEIR 5,

notes at the bottom of that table that for dominant genetic effects the spontaneous burden, that is that we would expect to occur in the population without the added exposure, would be 10 per 1,000 live births, and that they note a doubling dose - and I think the easiest place to see this is on table 2.1 which is page 179 of our materials in note A - a doubling of dose for chronic exposure of 1 sievert.

So have I interpreted that correctly then that if --

A. Well, generally, yes. You notice that the tables you are referring to are 20 pages apart in the text?

Q. Yes.

A. As I said in the direct evidence, the whole issue of radiogenic genetic effects is uncertain because there is no demonstration of these effects in man. These numbers come from a variety of sources mainly from mice, and there is a variety of estimates that are documented in sources such as the UNSCEAR Exhibit 621.

But the main qualification I think I would make with respect to table 2.1 is that the committee says that this doubling dose of 1 sievert is probably conservative with respect to man. It's the

doubling dose in mice and it is a bit too small, perhaps a factor of 3.

Q. Just so we understand what a doubling does is, that's the dose that would be associated with doubling the normal incidents of these genetic disorders?

A. That's right.

Q. So just then, given your caveats, that if we want to express it in a manner similar to the way they have expressed the fatal cancer effect, that works out at about 1 times 10 to the minus 2 to as opposed to the 5 times 10 to the minus 2 for cancers?

A. I'm sorry, could you repeat that?

Q. I was just taking 10 per 1,000 and you would expect that from 1 sievert.

A. Well, I think you are misapplying it, because you are talking only about the dominant category. And if you look through that table, which is complicated, they are many different kinds of genetic effects, and you will notice that the estimate for other multi-factorial is 1,200 per 1,000. So obviously you have to take these kinds of data with a procedure for applying them.

Q. Yes.

A. Now, it's not true that the doubling

does applies only to dominant.

Q. So the number would actually be higher. I didn't focus on other multi-factorial because --

A. No, sorry that wasn't my point.

My point was you can't take single numbers out this table and apply factors to them. These are factors that are derived from mice. This is the spontaneous burden I presume in man, and I don't think it was intended at all that it would be used in that way.

Q. All right. I understand your concern.

Just to explain the other multi-factorial, that's the incidence of diseases which the committee feels is partly associated?

A. They are listed, I think some of them are list in footnote F, but it's believed that heart disease and many other common diseases have at least a partial genetic basis.

Q. So that is why you can have a number greater than per 1,000 there.

A. That's right.

Q. I take it that it is the dominant disorders that are commonly felt in the scientific

community to be the ones most likely to be where you would most likely see a significant increase from radiation exposure?

A. Well, these are the ones that would appear probably in the first generation.

Q. All right. And so we would expect some of those disorders would then be inherited to the extent that the disorder is not so serious as to stop reproduction in the first generation?

A. That's true. The range of what you want to call a disorder or even mutation would include a lot of things that we would probably treat as normal variations.

Q. All right. And just in terms of the dominant category, looking at table 2.5, note D indicates that they view it likely that 2.5 of the 10 would be clinically severe and 7.5 would be clinically mild. And that's the distinction you are making?

A. Yes.

Q. BEIR does not estimate sources of exposure and UNSCEAR does; is that correct?

A. UNSCEAR does, yes.

Q. And we have produced some of the UNSCEAR material. Again it, I believe, has an exhibit number already. We reproduced it starting at page 182

of ours.

Mr. Campbell tells me it's Exhibit 321, Mr. Chairman.

THE CHAIRMAN: Thank you.

MR. D. POCH: Q. Table 6 of the appendix in UNSCEAR dealing with nuclear power is reproduced at the top of page 183. There the U.N. Committee looks at the collective dose per unit practice of nuclear power generation as they have estimated based on the information they have from actual releases from every kind of reactor around the world, and simply expressed it on a per gigawatt annum. Is that consistent with your understanding, Dr. Whillans?

A. I think so, yes.

Q. And there is where we see 230, I think person sieverts would be the appropriate language, per gigawattyear over all time and 24 in the next 100 years?

A. Yes.

Q. All right. And it's fair to say that CANDUs are better in some categories an worst in others in terms of the emissions?

A. Yes. It's not just CANDUs. I think this averaging process averages out a lot of variation.

Q. Right. And indeed, if we turn over

to page 185 of our materials, Exhibit 577, we see, for example, table 34 deals with tritium where HWRs, which the CANDU is an HWR, heavy water reactor, is that right, Dr. Whillans?

A. That's right.

Q. Are roughly 10 times other reactors. Similarly, carbon-14 in table 35 at the top of page 186, 6 to 20 times worse, but on the other hand, for iodine for example, table 36, HWRs fair better, ranging from 6 to -- much, much better than gas reactors; fair?

A. Yes. I just note that all these three tables are the normalized local and regional collective doses.

Q. Okay. And then there would be global commitments in addition?

A. That's what we discussed with --

Q. Yes, I understand.

Indeed, just looking at Exhibit 620 which you provided, which is sources of carbon-14 exposure.

A. Yes.

Q. Do I understand this correctly that --

A. Perhaps you could give me a moment to get a copy of that.

Q. Sure.

A. Okay.

Q. Looking at the global dose commitment, from heavy water reactor operation just from carbon-14 and not integrating over all time, but with a cutoff of 10,000 years, you show on the second page of your exhibit, 490 person sieverts per gigawatt year; correct?

A. That's right.

Q. And so that's almost twice what UNSCEAR finds for all types of exposures from the average reactor over all -- I'm sorry, again they have limited it to 10,000 years not over all time in table 6 of UNSCEAR, which is at our page 183 again; fair? We are comparing apples and apples?

A. You are referring to table 30?

Q. Table 6 at page 183 of Exhibit 577 which is parts of Exhibit 621.

MR. B. CAMPBELL: Mr. Poch, just so we that get it on the record. My copy doesn't have a table number on it. I take it table 6 is the table at the top of the page that's 183 of this exhibit?

MR. D. POCH: Yes. Collective Dose Per Unit Practice of Nuclear Power Generation. It's from page 27 of the appropriate section of UNSCEAR.

DR. WHILLANS: You are comparing the

value 230, which is over 10,000 years with my value of 490 over 10,000 years.

MR. D. POCH: Q. Yes. And I am noting that the reactors we are dealing with in Canada, because of the high, the relatively high emission of carbon-14, that one emission in fact would account for a population dose commitment twice what the combined emissions of all emissions are for --

A. It's not really combined because it is averaged. This is per gigawattyear for an average reactor.

Q. Yes. And that's for all radionuclides though.

A. We were talking about, as I had a fairly detailed discuss the other day, we are talking with a doses which mainly occur in the period beyond 500 to 1,000 years from now and about which UNSCEAR recommends that you apply considerable caution in interpretation.

Q. Yes, I understand that. But they in fact --

A. I think the fact that this number is larger is well within the uncertainty in the modelling as well.

Q. All I am suggesting to you is that

just looking at this one radionuclide which you have provided the UNSCEAR numbers on and they are for a consistent time period with the numbers they have provided for all radionuclides for the average reactor in the world, CANDUs do in fact on that time scale, given the uncertainties you have spoken of, entail larger, significantly larger population dose commitment?

A. I don't think I would agree it's significantly larger dose over a meaningful time period.

The numbers that I have given - unless I made some sort of conversion error - came from the same document and they have come from the section of the document that refers specifically to carbon-14 and to heavy water reactors. And it is true that the information in that section of UNSCEAR 1988 is mainly from the Argentinian reactor because they don't have Ontario Hydro data referenced in this material.

So there is certainly at least a factor of 2 uncertainty in whether 490 applies. I am using the numbers that are directly out of the document. I would say they are not different.

Q. Okay. Let's proceed then just using the number 230 that they provide, and I understand that

the carbon could be twice that but you express some doubt about the level of certainty to place on the number that you have provided us.

A. Yes.

Q. Tell me if my calculation is correct then. If we assume four reactors of 881 megawatts or .881 gigawatts per unit --

A. Are we talking specifically about Pickering?

Q. No, I am talking about a future station similar to Darlington.

A. Okay.

Q. I just wanted to get a sense of --

A. If we are talking about that then we need to talk about a different carbon-14 emission rate.

Q. Fair enough. I was just going to use the 230 for this back of the envelope calculation.

I take it you are comfortable using the 230 as a back of the envelope and I will treat it as such, it is just an approximation, but for the sake of getting a feel for the scale of the effect.

A. Back of the envelope, and also with the very large qualification that this is based on doses over 10,000 years, 90 per cent of them are past 100 years, and there are cautions throughout that

section of UNSCEAR that these are very much speculative.

Q. I understand all that. And you would agree that they have estimated that 10 per cent would be in within the first 100 years?

A. That's right.

Q. So I could just then go four reactors times .881 gigawatts per reactor, times the capacity factor, I have chosen .75, times 40 years, which is the expected life of that station, times the 230 person sieverts per gigawattyear, and I came up with about 24,000 and change person sieverts. Then I multiplied that by the --

A. If you are going to ask me to confirm any of this, I think we better stop there for a moment.

Q. Sure.

A. Talking about a 4 by 881?

Q. Yes. So 4 times .881.

A. Yes.

Q. Times .75?

A. 75 per cent.

Q. For 40 years?

A. Forty years.

Q. Which gives us the gigawattyears and I am multiply it by 230 person sieverts per

gigawattyears. That's roughly 24,000?

A. Just a moment.

That's approximately what I get, yes.

Q. And if we take your 5 times 10 to the minus 2 that you have offered for cancer deaths per sievert, multiply those two numbers together, I get something in the vicinity of 1,200.

A. That multiplies correctly, yes.

Q. So we would expect, with all the caveats that you have given about uncertainty, that over the 10,000 year period, the dose commitment from routine operation and associated activities of a single Darlington-sized station, we would expect that 12,000 premature cancer deaths.

MR. PENN: A. Twelve hundred.

Q. Twelve hundred, yes, absolutely.

[3:22 p.m.]

DR. WHILLANS: A. Now, can we calculate the number of cancer deaths in a population of 10 to the tenth over 10,000 years?

Q. No, Dr. Whillans, it doesn't matter to me because I am comparing options for providing electricity, and those people out there who are going to get cancer from other causes will get it whatever option we pick, and I am just looking for the

differential.

A. I am not sure I agree with that.

I guess the point I am trying to make is that I have mentioned many times and we are ignoring it anyway, these calculations out to 10,000 years have meaning only in a very general sense for very many reasons, the question of what health effects will be important, the very real questions of what kinds of controls will be in place in 100 years, and UNSCEAR itself says "do not use these numbers in that way".

Q. But you have in fact offered them in that way in Exhibit 620, haven't you.

A. I don't see any interpretation in 620.

THE CHAIRMAN: My memory may be wrong, but I thought 620 was produced at the request of one of the cross-examiners.

MR. D. POCH: No, I think this was offered by Mr. Johansen or Dr. Whillans to clarify this question of carbon-14 exposure.

DR. WHILLANS: I did.

MR. B. CAMPBELL: It was a matter that arose from a question from Dr. Connell in which Dr. Whillans used this material to further answer a question that Dr. Connell had raised.

THE CHAIRMAN: All right.

MR. D. POCH: Q. Dr. Whillans, I understand your concerns about the uncertainties surrounding such a number, and yet I think you have stated them clearly and I have noted them.

DR. WHILLANS: A. It is not just the uncertainty in whether the number is correct or not; it is a question of the interpretation.

I am not disagreeing with your calculation. What I am saying is that the people who produce these numbers specifically point out that they can't be used in a simple estimation of how many people will die of cancer as a result of 40 years of operation of a station.

Q. And they put that caveat on it for the very reasons you have offered; isn't that fair?

A. Those are some the reasons, yes.

Q. Okay.

A. I would also point out that the -- well, your table shows it. The bulk of this collective dose is due to mill tailings and specifically to the radon exposures resulting from it, and there are mitigation measures that can easily be applied to reduce those if it is believed worthwhile to do so.

So these are not necessary cancer deaths

as a result of 40 years of operation of a station. They are just for comparison purposes and for deciding on whether or not it is worth taking certain actions.

Q. That's fine. Dr. Whillans, you are not offering us any better number for the long-term health toll, are you, from this option?

A. Well, I agree with UNSCEAR. I don't believe it is meaningful to offer any number for the purposes that you are using them. Beyond a period of 100 or perhaps 500 years the uncertainty is so great that the number is meaningless.

Q. Just looking at what UNSCEAR suggests, then, we could assume 10 per cent of this in the first 100 years, 120 deaths?

A. Table 6? Yes.

Q. Yes.

A. Again, you will notice that on average that is dominated by occupational exposures, and we have given estimates of the specific occupational exposures that apply to Ontario Hydro operations.

Q. I thought you had just indicated that the bulk of this was due to mine tailings, radon emissions, which wouldn't be occupational exposure, would it?

A. In the 24 which is 10 per cent of the 230, the left-hand column, it lists over the next 100 years the sources.

Q. Yes.

A. And 12 of the 24 is occupational exposure.

Q. The near term is dominated by occupational as opposed to long term --

A. Yes.

Q. All right. Thank you. Now, these numbers we have been talking about with all the caveats you have placed on them, in addition to that we would have non-fatal cancer, whatever suffering is caused by non-fatal cancers?

A. Well, the number 5 times 10 to the minus 2 that we used in our risk calculation referred specifically to fatal cancer, yes.

Q. Do you have any idea what the ratio is to be expected as between fatal and non-fatal cancers?

A. Well, it certainly varies with the cancer site. The number that ICRP has used over the years is roughly a factor of two.

Q. Factor of 2? Twice as many non-fatal as fatal?

A. An additional equivalent number.

Q. Additional equivalent number, okay. And in addition to this we would have the genetic mutations induced by radiation we spoke of earlier; correct?

A. Yes, which ICRP suggests are the order of 10 per cent of the fatal cancers.

Q. And again, some of those would be inherited and presumably --

A. The ICRP number is for all generations, yes.

Q. All right. Now, does it matter that the dose for any individual is less than that received from background radiation?

A. Sounds like a generally good thing. I don't understand what you mean: does it matter.

Q. If we are comparing this reactor to either another reactor or another electricity-producing option or saving option, you would agree that it doesn't matter, would you not, whether this is above or below background levels; what we are looking for is the difference between the options?

A. Well, I guess in my mind it matters when it is so far below background that it is comparable with or smaller than normal variation in

background. In other words, if someone chooses to live in a brick house rather than a frame house he incurs a radiation dose greater than he would from living near a station. I think that sort of thing matters.

In the absolute sense I have said that we assume that any increment of dose carries a detriment, and so in that sense I agree with you that we should be cautious to control all doses.

Q. Well, perhaps I can put it another way. I think it was Dr. Connell who asked one of you where you would spend a billion dollars to reduce risk in Ontario, and your reply was: not in the nuclear field.

A. I think that wasn't my reply, but...

Q. Oh, all right. Perhaps it was one of your colleagues' reply.

But what I am suggesting to you is if we are not looking at a menu that includes expenditures on road safety, for example, if we are only looking at a menu of options for meeting energy needs and we must select one, then isn't the factor that we should be looking at the differences between those options, and it matters not whether it is the most cost-effective place in society to spend money to reduce exposure or indeed what fraction this exposure is of background or

other --

A. I think I agree with you as long as we include all risks, and particularly all radiation exposures, and don't overlook some because we are not expecting to find them or because they are trivially small.

For example, I calculate there is something like 20,000 person-sieverts of radon exposure in Ontario every year - this has nothing to do with mine tailings - and those exposures occur mainly inside buildings because of reduced ventilation, and Mr. Hamer asked me about this, and I tried to resist the way he was leading me, but it is certainly true that if you don't take appropriate mitigative actions increased energy efficiency in houses can lead to far greater exposures than we are talking about here.

Q. You are aware that part of Ontario Hydro's programs, in fact, when they go in and suggest R2000 standard houses is to include an air-to-air heat exchanger?

A. Absolutely. Absolutely.

Q. And that is both a health advantage and an energy advantage. You are aware of that?

A. That's right.

Q. Okay. I just have one other set of

questions in this area, but, Mr. Chairman, it might take a few minutes so perhaps we should take a break.

THE CHAIRMAN: We will adjourn then for 15 minutes.

THE REGISTRAR: Please come to order. This hearing will adjourn for 15 minutes.

---Recess at 3:30 p.m.

---On resuming at 3:50 p.m.

THE REGISTRAR: Please come to order. This hearing is again in session. Be seated, please.

MR. D. POCH: Q. Just a couple of points on the epidemiological studies, Dr. Whillans.

You have made the point with respect to occupational exposure studies that the samples tend to be small by statistical sampling criteria, apart from the study that was done -- well, I'm sorry, for occupational studies? That is a problem with epidemiological studies of occupational populations?

DR. WHILLANS: A. Well, some of them are much bigger than others. If we look just at Hydro's experience, that is small compared with say an international occupational study.

Q. You have also pointed out there --

A. They are all small compared with the person sieverts in the Hiroshima/Nagasaki data.

Q. And you have pointed out the healthy worker effect, but would not another factor be that there is a sort of wealthy, educated worker effect?

A. An effect on health?

THE CHAIRMAN: Did you say "wealthy" or "healthy"?

MR. D. POCH: Q. "Wealthy", with a "w", and --

DR. WHILLANS: A. Effect on health.

Q. Yes.

A. Actually, I think when you look at some diseases they actually increase with social class, so I am not sure that it would apply generally.

Q. There is some potentially confounding factor there of education and --

A. Many potential factors, yes.

Q. And so I think it was AECL who put in front of you Dr. Hare's comments where he noted in his findings that there hadn't been any finding of health effects amongst your workers?

A. Amongst our workers, yes.

Q. You wouldn't expect to see one, would you, given all these factors, assuming that the Japanese data, that the results from the Japanese data are correct?

A. Well, I think what I would point out is that when we have such a small sample size we can't look within the data as they did in the UK study where they were able to look by dose category. When we divide it into dose categories there is one or zero in each category, that sort of situation.

Q. And indeed, before these various reasons, the healthy worker effect in particular, you would expect to find an SMR for the group as a whole, standard mortality ratio, lower than in 1 in places like Chalk River?

A. It is generally true in occupational groups the SMRs tend to be less than 1, yes.

Q. So an SMR approaching 1 is not inconsistent with a dose effect comparable to that we have seen in the Japanese data; it is just it is disguised by virtue of the healthy worker effect, small sample size, and so on?

A. I think if your question is do any of these occupational studies exclude a risk similar to that that would be derived from Japanese data, I think the answer is: No, they don't.

Q. So you are comfortable then that the Japanese data are perhaps the best we have?

A. Well, there certainly are

limitations, and I mentioned some of them: the acuteness of the exposure; there are also not insignificant problems of extrapolating from a Japanese population to a North American population because their baseline cancer levels are very different for some sites, like stomach and breast cancer.

So there are problems, and that is why I think there are a number of groups trying to develop studies which use the occupational experience from a number of different sources.

Q. I wanted to turn to ALARA and discuss with you what -- focus on the word "reasonably" means in that definition.

If you could bear with me, so we could structure this discussion, it seemed to me that there were three interpretations that come to mind, the first being you could set a target to achieve a given level of health impact such as accident risk comparable to other industries in some absolute sense or relative to other industries, or, second, you could simply cap what your target is by affordability.

I should just say I assumed this one is not in the running because of course we get the perverse result that if as conservation gets cheaper nuclear power to compete would have to be cheaper and

so we would have less safety if affordability as compared to other options was the criteria.

But the third one that came to mind was to set a level where the impact and risk reduction attainable for the next marginal expenditure would be too expensive based upon the benefit foreseen for that expenditure.

I took it that it is the latter that in practice is the driver; is that fair?

A. Well, the definition doesn't give much help. It is social and economic consequences taken into account.

In my view - and this is where we ran into some problems when we were talking I think with Ms. McClenaghan, but perhaps it was someone else - about the dollar value that should be applied.

The traditional ALARA analysis has two terms: one is an objective component where you just take into account some of these measure that you are talking about; the other one is I think called a subjective component where you take into account softer things more difficult to measure, like perception of risk and so forth.

I think because of this softer side of it it has always been applied, in my experience anyway, in

a fairly general way. And so, you know, we have examples where a certain dollar value was used to decide whether or not to apply a certain mitigation measure.

But I think in general and in the everyday decisions that get made in the workplace it is a much more general process. It is not just a matter of writing on the back of an envelope: This will cost so much and we are going to save so much dose at $10,000 per person-sievert, this is not economic. I don't think it is done that way.

Q. Perhaps you could turn with me in Exhibit 577, our first volume of materials, to page 189A.

This has been referred to earlier. This is the Atlantic Nuclear Services Study for the AECB on Cost-Effectiveness of Reduction of Off-Site Dose.

I don't unfortunately have an exhibit number for it again. My apologies.

But if you would turn with me to page 189B, the abstract --

MR. JOHANSEN: A. Mr. Poch, perhaps I could help.

Q. Yes?

A. You are looking for the exhibit

number--

Q. That would be helpful.

A. --that was given to Energy Probe's version?

Q. That's correct.

A. I believe it was assigned number 520.94.

Q. All right.

A. That is the interrogatory number which --

Q. Yes, and this study was attached to that interrogatory, I understand, as well.

A. Yes.

Q. This is not where we happened to get it, but it is the same study.

A. That's my understanding.

Q. And I just read the first paragraph there of the abstract where the second sentence reads:

> The AECB initiated this study of the cost effectiveness of the reduction of off-site doses as part of a review to determine if further measures to reduce off-site doses might be reasonably achievable.

And it was from that that I was drawing

this conclusion that there is a move towards this approach of, in essence, a cost/benefit test to interpret "reasonably achievable", to interpret ALARA.

Is that your experience, Dr. Whillans?

DR. WHILLANS: A. Well, yes. When I went through the three pillars of the ICRP protection process, optimization was a cost/benefit process and ALARA was the guiding principle.

Q. And indeed, if you would turn in Exhibit 578, which is our second volume of materials, to page 102, this is -- page 102 through to page 128 is the text of a report which was provided as an attachment to Interrogatory 9.6.46.

THE REGISTRAR: That has previously been entered, 520.108.

MR. D. POCH: Q. And Dr. Whillans, I think you will recognize that this is an Ontario Hydro study of the application of the ALARA principle to normal radioactive emissions from Ontario Hydro facilities that, while it does not bear a date issued, it has a code attached to it which seems to indicate it came from 1985. Is my interpretation of that code correct?

[4:00 p.m.]

DR. WHILLANS: A. I think that's

correct, yes. It's a task group report.

Q. Yes. I am looking at page 106 of our material, and this refers to -- in the strategy section at the bottom in the middle appears the notation:

> The method is a based on applying cost/benefit analysis to aid management in optimizing control over normal emissions.

And at the bottom:

> A formal approach was selected to enable Ontario Hydro to demonstrate it's application of the ALARA principle to the Atomic Energy Control Board and the public.

I take it that that's the conclusion of the task force. That's their recommendation?

A. Well, I think this report describes the development of this formal approach.

As I said, ALARA has been a process that has been in use for 20 years, I guess, at least. And I think I also mentioned in my direct evidence that in the last five years or so, perhaps longer, the AECB about has focus add lot of its effort on driving licensees to a more common demonstrable use of ALARA, and I think this was in response to that.

Q. Yes. So in fact, this is not just a recommendation, this has been carried forward in practice?

A. I think that's what this document is. I think it is describing what the document is going to give, a formal approach.

Q. And if you could refer to page 107 of our materials, page 2 of that report, under application guidelines, it reads:

> The process should be applied whenever Ontario Hydro is considering defining or changing the radioactive release targets or control or monitoring practices for existing or new facilities.

You would agree with that?

A. Yes.

Q. Just so we understand what the mathematics come out to under the section below that under general equations, I think the prose that was clearest to me is the second paragraph where it says:

> The condition that any potentially reasonable change must necessarily result in a net societal benefit is expressed in the equation.

And that is the test in essence, is it

not, Dr. Whillans, you look to see if there is a net societal benefit?

A. Yes. And on the following pages are the objective and subjective benefits that I spoke of.

Q. Yes. And indeed, at page 109 of our materials appears under objective, at the very bottom, there is suggested there that $10,000 per public person sievert in 1983 dollars was an appropriate term to use.

I think elsewhere in the evidence you have pointed us to a range of going up as high as 100,000 depending on the particular circumstances?

A. Well, within this document on page 115 of your exhibit there is a table which gives the range that was available in 1985, I guess. And what I said in response to earlier cross-examination was that Hydro has another task group in place to look at whether the recommendations in this document are still appropriate, and they have a comparable comparison of what is used in other jurisdictions. On the basis of that evidence they are likely to be recommending some sort of a variable cost figure which would be a higher per unit does for higher doses.

Q. All right. The current target, that is the 1 per cent of regulatory limits which is your target we have heard many discussion of.

A. It's the upper level for our range of emissions.

Q. Yes. That or whatever your particular sub target is for a particular radio isotope, I take it that, first of all, the setting of that may have predated this formalistic approach, but it was intended to have the same result, that is that you were looking for this point of reasonableness where you felt the cost-effectiveness of dose reduction, that limit had been approached or passed?

A. Well, maybe Mr. Johansen will add to it, but my understanding is that that 1 per cent comes from the early 1970s. And the ALARA process was a concept but it wasn't formalized in this way, so I doubt if it were done on a cost basis at that time. I would guess that it was probably done in relation to the limit and to background and probably not on a dollar basis.

Q. In practice, as you have indicated, you surpassed that limit depending on the radio isotope, that is your better the limit?

A. For some classes it's generally better and for others it's close to 1 per cent.

Q. So your current practice, in fact, on the ground is reflective of an understanding of what is

reasonable in a cost-effectiveness use of the term, not in every case but in most cases?

A. Well, I think our current practice is -- well, there are exceptions.

In general, for emissions which are usually well below 1 per cent I would expect that given the considerations about long lived that you have with carbon-14 and so forth, that we are probably not likely to focus on reducing them in preference to focusing on something like tritium which is much closer to 1 per cent.

Q. Do I take it, though, and I don't want to misuse the term, but I take it that your decision of what to focus on and how far to go is formally or informally a question of what is reasonable given the options available, the effectiveness of those options and the cost of those options relative to the benefit?

A. I think that's fair.

Q. Would you agree that as we saw in our discussion of reactor safety, that the understanding of what the consequences of the releases are has changed in the last few years on the order of a fivefold change with the new interpretation of the Japanese data?

A. When you used the value 5 yesterday I

was going to object slightly. I think that's sort of an upper limit.

For the worker age group it's clear it's about a factor of 3 since 1977. In '77 there really wasn't a number for the public, and I think a factor of 5 is the upper end, but I will accept that.

Q. All right.

A. And your question, I guess, was, based on the knowledge that the risk or the costs are 3 to 5 times higher, do we still feel this is a reasonable level.

Q. Well, I guess my question is: Wouldn't you agree that in either a rigorous cost/benefit analysis or in some less rigorous approach, reasonable approach, or whatever approach you take, the point, the cutoff point, cost/benefit being equal or reasonableness in light of the benefit to be obtained my mitigation, has just shifted in light of that change?

A. Yes, certainly the cost has increased, yes, or the benefit, if you think of avoided doses.

Q. And I was interested that when we asked you at page 189 of Exhibit 577 in Interrogatory 9.7.65--

THE REGISTRAR: That's .118.

---EXHIBIT NO. 520.118: Interrogatory No. 9.7.65. (page 189 of Exhibit 577)

MR. D. POCH: Q. --about standards, and we worded it: Needed to be tightened fivefold to reflect renew risks estimates, you disagreed with the preamble. You pointed to how there was going to be 60 per cent reduction in the occupational doses from the ICRP. You didn't provide us there with the new public doses, but I take it you have since provided and indicated that in fact there will be a fivefold tightening in the public doses.

DR. WHILLANS: A. That's certainly what is proposed.

I think there is a bit of confusion about this factor of 5. The public dose limit has been 5 millisievert per year in the past and it is proposed to be 1. But, in fact, in 1977 in ICRP 26 it was said that it should be 5 in any one year but the long-term average should be about 1 or less. And so what they have done is sort of re-emphasized the 1.

I mean, one of the problems is, we are now talking about doses below background.

Q. I understand the difficulty in monitoring --

A. I just was pointing out that I think this factor of 5 doesn't come straight out of a comparison of ICRP 60 and 26. It's because the limits are proposed to change by a factor of 5.

Q. I think that's my point precisely. The 5 doesn't come from ICRP. It's the result of the more basic science, if you will, the re-evaluation of the Japanese data, and this range of 3 to 5, I think, is fair?

A. I agree.

Q. And wouldn't you expect that in light of that change in understanding of what the risks are, that we would expect to see the AECB; or you would expect to see the AECB or you would voluntarily in your interpretation of ALARA expect to see a shift that reflects that ratio in your practices?

A. No, I don't think necessarily reflecting the ratio. I would expect us to see a re-examination of the where the emissions are ALARA given the new cost/benefit ratio.

Q. Okay. One other point in the area of regulation, a slightly different matter.

If you could turn to page 204 of Exhibit 577. I think this be for you, Mr. King.

I'm sorry, page 194.

MR. D. POCH: Mr. Chairman, pages 194 to page 207 are a document, Current Safety and Licencing Issues.

Mr. King, can you confirm that this is the minutes of a meeting of the SOATIC Committee?

MR. KING: A. I can't confirm that. It doesn't say that here.

Q. I included the press reports on the previous two pages to provide that context.

A. If you are asking me based on my knowledge whether this is the minutes of the SOATIC meeting, I do not know that.

Q. Mr. Penn, can you help us with that?

MR. PENN: A. Well, I am not a member of SOATIC. I occasionally see the minutes. This looks to me like a presentation.

Q. Yes.

DR. WHILLANS: A. Mr. Poch, I can read just about read mine, and it says presented by some name that looks like Humphries to SOATIC. It looks likes a presentation.

Q. All right. That's fair. Not minutes of presentation.

Is your understanding is that that's what this document is, Mr. Penn?

MR. B. CAMPBELL: Just a moment. Whose notation is that?

MR. D. POCH: We don't know.

THE CHAIRMAN: I think we should have some idea what it is. This is such a loose hearing, I can't believe I am asking this question, but does anyone have any idea who Humphries might be?

MR. KING: I am aware of Mr. Humphries. I am aware that he produced a document like this a few years back. I did not have knowledge of how he used that document.

THE CHAIRMAN: Who is he?

MR. KING: He is a former staff member of AECL in the licencing area.

MR. D. POCH: Q. Mr. King, could you tell us what SOATIC is?

MR. KING: A. I am sure Mr. Penn can.

Q. Mr. Penn?

THE CHAIRMAN: Even though he is not a member of it.

MR. PENN: Well, I can't remember what the actual acronym stands for. But what in essence it is, is a joint senior committee of Ontario Hydro and Atomic Energy of Canada limited, which meets from time to time. I don't know whether they meet regularly or

not, but they meet from time to time.

MR. DALY: My recollection is it's Senior Ontario Hydro AECL Technical Integration Committee.

MR. PENN: Good.

MR. D. POCH: Mr. Chairman, I can't, apart from what these witnesses have helped me with here, I can't help you further with identifying the document because the source of this document, I think it is clear from the press reports, is that it was a leaked document. And indeed, we act for Mr. Tim Grant who has had a freedom of information request in I think for some years now, to obtain the various minutes of the SOATIC committee and he has been turned down. Although that we were successful in getting an order from the Information Commission and released an edited version of those minutes, and there is a judicial review in the works with respect to that.

THE CHAIRMAN: I take it they are not being introduced to prove anything, or make any points. They are just there to help you ask these witnesses questions, if they know the answers to them.

MR. D. POCH: Yes. And perhaps, when and if AECL takes the stand they will be able to identify the document more accurately.

MR. PENN: Anyway, whatever it is, Mr.

Chairman, it's not minutes. These types of meetings presentations are made by Ontario Hydro or AECL staff to the Committee, and I presume that's what this is.

MR. D. POCH: Q. All right. With that understanding, Mr. Penn, perhaps we can use this document to structure a few brief questions. I think we spent more time introducing it than my questions.

Page 195 there is a sheet with respect to C77. C77 was a regulatory initiative proposed from the AECB, Mr. King?

MR. KING: A. Yes.

Q. I notice under strategy it said:

> An industry wide committee is discussing C77 with AECB staff with aim of negotiating an acceptable compromise.

Is that a process which you are aware of occurs either with C77 or with respect to other AECB suggested initiatives?

A. Well, I am somewhat familiar with the issue that was involved when C77 came out, and I am sure both -- or I can only speak for Ontario Hydro, in that we had some difficulties with the way it was worded and we made those known to the Control Board. But as I mentioned a couple of days ago when I was requested, are these documents given to us beforehand

earlier and they are not, we get them at the same time as the public gets them.

I don't believe the use of the terminology here, negotiating a compromise, it's certainly not terminology that I would use.

Q. Fine. Mr. King, if you turn to page 204 of our materials, this is a discussion of another issue here, thermosyphoning. I was again interested, the background offered suggests that AECB staff found our predictions, I assume that means AECL's predictions, of two-phase thermosyphoning difficult to accept during licencing of CANDU 600 plants. And that the staff position, and I assume that means AECB's staff, is that they do not consider the issue resolved. Low speed drives have been put on hold but may still be required if sufficient experimental analytical evidence is lacking.

I wasn't going to ask you about the specifics of that, but rather that general interaction, has it occurred to your knowledge where a plant has been licenced where the Control Board staff have reservations and they have required further work to resolve the issue at some later point?

A. That's probably happened in the past where they may have some residual concerns which they

do not consider sufficiently important to deny getting a licence or a licence renewal, but they asked us to continue work in that area for one reason or the other, and I think that has probably happened in the past.

Q. And I take it's not uncommon for Ontario Hydro to indicate to the Control Board the costs associated with suggestions that the Control Board staff might have as a factor to be considered, just as it's a factor in ALARA for radiation releases, it would be a factor in determining the appropriate course of action in a safety related issue?

A. I am sure if we were having discussions with them we would bring out all factors, technical factors, cost, occupational dose, the whole range of pros and cons surrounding an issue.

MR. PENN: A. I might add that they don't usually take much notice of cost; they take more notice of human safety.

Q. Mr. Penn, I take it that nuclear power will provide 50 or 60 per cent of the electrical energy in Ontario if and when Darlington is operating?

A. Yes. In my lead-off direct evidence I gave the figures for what it would be in 1993. I think it was about 60 per cent, and by 2009 I think it got down to about 52 per cent.

Q. I am wondering what would happen and to what extent costs would be a concern if you found a generic problem with all of your reactors, all being of the CANDU variety, different vintages, whether it had a safety implication or simply an implication which affected the energy availability, what kind of cost implication would we be facing if we had to shut down all these reactors for days, weeks or more?

[4:22 p.m.]

A. Well, the only generic issue that I can think of that has happened, so far as we have had more than 20 years of experience in calendar time and, as we have given evidence here, over 200 years of reactor experience of operating these plants, is the pressure tube issue.

Q. And you have not shut them down simultaneously for that one?

A. Oh, no. I'm sorry, I misunderstood you.

Q. No, I was imagining, for example, we find that there is some manufacturing fault affecting a safety-critical valve that can perhaps even be replaced in a matter of weeks but that it affects all of the plants.

I am wondering in that scenario if we had

to shut all of the reactors down simultaneously out of an interest for safety has anybody analyzed what the cost and disruption involved in that would be?

A. Well, because it is totally speculative, but the replacement energy for a 500 megawatt unit that I can recall is about just under $300,000 a day.

Q. It may not be for this panel, but can you tell me, is it possible to replace 50 or 60 per cent of the electrical energy in the province from other sources?

A. I think --

Q. I am talking about with short lead times.

A. Given your example, which I just can't contemplate how it might happen, but I would imagine that we would do what we have done in the past on a very hot day when we can't meet the load. We would make an appeal to the public to not use power unless it was absolutely necessary.

And that, with a combination of purchasing power and switching voltages, lowering voltage and this sort of thing, is what we would do.

But this is a planning matter, and I am only speaking from general knowledge.

Q. Mr. King, in that scenario mightn't the regulators feel compelled due to the costs and the dramatic cost of interruption, mightn't they be compelled to relax standards on a temporary basis?

THE CHAIRMAN: I am not sure how Mr. King can answer that question. That is something you have to ask a regulator.

MR. D. POCH: Mr. Chairman, I thought I had set that up with my earlier question where he agreed that cost was a factor that they presented to the AECB.

THE CHAIRMAN: How a regulator may approach this thing is something that Mr. King cannot answer. And if he did, it wouldn't be worth anything.

MR. D. POCH: That's fine, Mr. Chairman. Okay.

Q. Gentlemen, turning to another topic, turn to page 209 of Exhibit 577, our background materials. This is Interrogatory 9.7.166.

THE REGISTRAR: Previously entered, .60.

THE CHAIRMAN: Thank you.

MR. D. POCH: Q. We asked you about capital savings that Hydro believes it had obtained from the various stations from building four-reactor designs as opposed to two or single units. And we were

referred there in the answer to Exhibit 57, which is the DSOS study and which is Exhibit 57 in these proceedings, and we have provided excerpts of that overleaf.

That was an answer you gave us last April, I note, in the 9.7.166, and if we look at Exhibit 57 at page 210 and 211 I note that these numbers are in '85 dollars, and just dealing in ratios I note dramatic differences between a 4 by 881 Darlington-type station and 1 by 600 --

THE CHAIRMAN: 210 and 211 come from the Demand/Supply Option Study; is that right?

MR. D. POCH: That's correct, Mr. Chairman. It is Exhibit 57 in these proceedings.

Q. And this is a dollars per megawatthour --

MR. PENN: Just for your own information, Mr. Chairman, this document was the subject of a Select Committee hearing in about 1984.

MR. D. POCH: Q. Yes, but you referred us to this, as I pointed out, I think, in April of last year.

As of April of last year you were referring us to a document which showed a ratio of capital costs between those two options as 1,500 to

2,300, Darlington to Point Lepreau for capital, more than a factor of 2 for OM&A, and about a 60 per cent increase for standard cost.

Can we just get an explanation of "standard cost", Mr. Penn? That is another form of LUEC which is intended to levelize costs for comparing options one to another; is that fair?

MR. PENN: A. Well, it is in a way, but I can't remember now the precise definition of "standard cost".

Q. That's fine.

A. It was a term and a method that we dropped once we developed levelized unit energy cost.

All I can tell you is that in about this period of time the standard cost of the system as a whole was about $31 per megawatthour to give you a feel for what these numbers mean.

Q. Yes. And I just was making the point that it is a cost used for comparing options?

A. Yes, it was. But it didn't capture, if I remember correctly, the total lifetime cost, and it was before the era that we developed this comprehensive nuclear cost model.

Q. I know that Mr. Shalaby on Panel 10, and I gather he was the architect of the standard cost

and is one of the architects of the LUEC --

A. Well, Amir Shalaby and Ken Snelson, yes.

Q. And they are both on Panel 10?

A. Yes.

Q. So we can perhaps get a clarification of that because indeed the opposite is my understanding, but without debating that, do I take it that since April when you referred us to this, since a year ago, you would no longer view this comparison as appropriate?

A. Well, without commenting on its appropriateness, when you asked the question this was the only information that could throw some light on the question you had asked, and, of course, we carried out the Preliminary Nuclear Options Review, as we have given testimony earlier in this hearing, starting in about July of 1991.

I would suggest to you that there is a significant amount of information on this type of subject now before this hearing that supersedes this much older information.

There is, for example -- and I could turn up the references if it is necessary, but certainly there are comparisons between a Darlington-type station

and four single units of CANDU 6 or four single units of CANDU 9 and new sites or existing sites, et cetera, and there is a complete detailed disaggregation of the costs including OM&A and fuel and everything else that is involved in that cost model.

Q. All right. Mr. Penn, would you turn to page 218 of our materials?

A. 218?

Q. Two-one-eight?

A. Yes, thank you. Yes?

Q. This is a report that appeared in Nucleonics Week, a trade publication we had cited in these hearings earlier, where Mr. Franklin is quoted. Mr. Franklin is the past president and chair of Ontario Hydro; correct?

A. At that time Mr. Franklin was president and chairman of Ontario Hydro, yes.

Q. And in the right column about halfway down in discussing other CANDU options, CANDU 3 in this case, he observed, in quotes:

> It does not have the vacuum building which we have concluded is a desirable for one thing. I'm not completely excluding it, but I think it is highly improbable.

Would you agree that a vacuum building is a feature that you have incorporated in your various stations and is seen as a desirable feature?

A. Well, we incorporated a vacuum building not only because it was a desirable feature but it was economically possible to do it and with a multi-unit station to integrate it.

I'm not exactly sure when I say this, but I happened to be with Mr. Franklin when we had a meeting with the Council of Deep River who were very interested in hosting a CANDU 3 in that area, and the main reason for Mr. Franklin's view on CANDU 3 was more related to its size on the Ontario generating system than any other reason.

THE CHAIRMAN: I don't know whether it makes any difference, but this publication is July 20th, 1989, and you met in...when did you say, in Deep River, was it?

MR. PENN: No, the Council and Mayor of Deep River travelled to Toronto.

THE CHAIRMAN: When was that meeting?

MR. PENN: I think it was in the summer of 1989. It was before the Demand/Supply Plan was submitted, anyway.

MR. D. POCH: Q. Mr. Penn, are you

agreeing or disagreeing that a vacuum building is considered a desirable feature?

MR. PENN: A. Well, Mr. Franklin was making a personal view there, and my personal view is that it is an additional desirable feature which is practical with an integrated four-unit station and clearly isn't practical with a single-unit station.

Q. All right.

MR. KING: A. I might add that when you design a reactor without a vacuum building, and what they have done in CANDU 3 is that you have to make other allowances in the design.

The design pressure of the CANDU 3 containment is much higher than our reactor buildings with vacuum buildings. As well, the leakage rate is much more stringent on a non-vacuum building design. And there are several other factors, too. So where you don't have a vacuum building you have to make other design provisions to get to the same or better level of safety.

Q. All right. Gentlemen, can I refer you to page 219A of our materials, Exhibit 577, and 219A through 219I are notes for remarks, I should say, by Mr. Mark Eliesen, who is the current Chair of Ontario Hydro, a speech he gave December 12th, 1991; is

that correct?

MR. PENN: A. That's correct.

MR. D. POCH: Perhaps this could get an exhibit number, then. It is not part of an interrogatory.

THE CHAIRMAN: It may already be an exhibit number, but we can give it another number now. What is the next number?

THE REGISTRAR: 640.

---EXHIBIT NO. 640: Notes re speech by Mr. Mark Eliesen, December 12th, 1991. (pages 219A through 219I of Exhibit 577)

MR. PENN: One thing I won't be able to tell you, Mr. Poch, is whether the chair stuck to these remarks that were put together by our writers in Hydro, of course under his guidance. But not being at the meeting I don't know whether he stuck to --

MR. D. POCH: Q. I can only assume that before it was released to us or anybody else Mr. Eliesen or one of his trusted advisors had a look at it.

THE CHAIRMAN: Mr. Penn's caveat is also on the text.

MR. D. POCH: Yes. "May not be exactly as delivered."

Q. Mr. Penn, I would like to turn your

attention to 219F and I will get your opinion then rather than focus on Mr. Franklin's.

First of all, Mr. Eliesen's speech in the fifth paragraph on that page says:

> At the same time, the cost differences between various large scale options, whether it is coal or a thermal generating plant or a nuclear station, become less distinguishable. Big central generation stations cost billions of dollars no matter what fuel they use.

I take it that indeed your evidence has been that the costs of coal and nuclear, for example, have tended to grow closer to one another, Mr. Penn, over time?

MR. PENN: A. I was referring to the lifetime cost, of course.

Q. Yes?

A. And I specifically stated that I was comparing a 4 by 881 megawatt with a 4 by 800 megawatt conventional steam-cycle fossil plant using U.S. high bituminous coal.

Now, of course, if we looked at a plant that used Western Canadian coal the cost difference would be far greater.

Q. And indeed, if we looked at some of the other nuclear options which cost more than the 4 by 881, as your evidence points out the difference would be less?

A. Well, I was comparing a 4 by 881 with a 4 by 800 so that we were comparing something, that we were in the same ballpark.

Q. Fair enough. Now, I think you put a number on it. You said in the range of 10 to 15 per cent, there was still a 10 or 15 per cent cost advantage to the nuclear lifetime?

A. On the assumption that theoretically the plants were in service in the year 2002, which was the year adopted by the Fossil Cost Review.

Q. Do I take it that that comparison you have made assumes, first of all, that it is on an existing site?

A. I think, subject to check, you are right, yes.

Q. And I take it that it assumes 80 per cent average capacity factor for a 40-year life?

A. It would for both of them, yes.

Q. And I take it that it assumes no delays in the construction?

A. That's correct.

Q. All right.

A. For either of them. It also assumed that the coal-fired plant would have scrubbers on it and low NOx burners for selective catalytic reduction.

Q. Now, just in terms of the cost of delay it has a bigger impact on options which have higher up-front capital costs such as nuclear, I take it?

A. As a general rule, yes. But it depends what the interest rates are, of course.

Q. Yes. And that is true in comparing nuclear to NUGs or any other option?

A. Yes.

Q. All right. And Mr. Eliesen goes on to note:

> We have learned more about the true costs of making electricity. Nuclear stations, which are responsible for generating 60 per cent of Ontario's electricity needs, cost a lot of money to build but were supposed to have significantly lower costs. It has turned out differently.

And he cites retubing being needed sooner than expected and the cost of keeping them maintained and staffed is

higher than expected, and new standards on health and safety called for by the AECB has meant greater than expenditures than has been anticipated.

Would you agree with those observations?

A. Well, there is no question that building a large power station costs a lot of money. No question about that whatsoever.

There is no question that on Mr. Eliesen's mind would be the troublesome problems with Darlington, and no doubt at the time he gave this speech, which was not too long after he became chairman of Ontario Hydro, he had gained an understanding of retubing.

Having said all that, I personally don't feel that one can say that nuclear stations are suddenly getting on a lifetime basis to have costs that are significantly different from what they have been in the past. I don't think that is true.

I think in our direct evidence we have indicated what the expected costs are in the future and what they have been in the past.

Q. I take it you wouldn't disagree -- you may disagree in the scale of the trend, but you wouldn't disagree with the trend he is pointing to, that these various factors have tended to increase

costs above earlier expectations?

A. I pointed out in my evidence that in real terms the cost of Ontario Hydro's nuclear stations in constant dollars per kilowatt has grown at about 2 per cent per annum.

[4:40 p.m.]

Q. Fine.

A. Now what I wouldn't call that personally a dramatic increase. But they have increased for the reasons that, some of the reasons Mr. Eliesen has mentioned.

THE CHAIRMAN: I'm sorry, which cost has grown 2 per cent per annum?

MR. PENN: The capital cost, Mr. Chairman, in dollars per kilowatt of the initial plant, that's the initial capital cost but including the heavy water and the initial fuel and the capital modifications that have occurred.

You may recall I put an overhead on the projector the other day that showed that trend in time, compared it with American costs, if you recall.

MR. D. POCH: Q. Could you turn to page 229 of Exhibit 577. This is the information you offered on CANDU 6 costing. This interrogatory has been given Exhibit No. 520.69.

I take it that the 4 cents offered in this exhibit, which appears at the top of page 231, if we wanted to get a feel for -- that would be comparable to the 3.7 cents you offered for the 4 by 881 alternative, Mr. Penn?

MR. PENN: A. Well, from memory -- well, I would really prefer to pull out the exhibit on this subject.

Q. All right. I think the exhibit you are referring to, if it's most convenient, is interrogatory 9.14.68A, and the copy I happen to have picked up doesn't have the exhibit number recorded on it.

This is the nuclear options preliminary review material?

A. That's what I am looking for.

Well, there are two documents that would help us in this. Interrogatory 9.44.2, that I know has also already been given an exhibit number but I don't have it marked on this one, then there is a response to an IPPSO inquiry in more recent times.

THE CHAIRMAN: Are they both the same document?

MR. PENN: No, they are separate documents, Mr. Chairman. I am just trying to recall.

THE REGISTRAR: The 9.44.2 is 520.29.

THE CHAIRMAN: And for those that have it, it's tab 17 of Volume 1 of the AECL brief.

MR. PENN: The other document that I was thinking of is Interrogatory 9.14.68A.

Is that the one, Mr. Poch?

MR. D. POCH: That's the one that I was holding up.

Has that been given an exhibit number?

THE REGISTRAR: That has not been entered.

MR. D. POCH: Perhaps it should.

THE REGISTRAR: That will become .119.

MR. PENN: That's 520.119?

THE REGISTRAR: Yes.

MR. PENN: Thank you.

---EXHIBIT NO. 520.119: Interrogatory No. 9.14.68A.

THE CHAIRMAN: We don't have that.

MR. D. POCH: It mysteriously appeared on my table, Mr. Chairman, and I can't recall who put it there.

THE CHAIRMAN: Mr. Penn, armed with those two documents, you can now answer the question, can you?

MR. PENN: Yes, I can, sir.

Actually, Ms. Betsy Harvie did enter them in the process.

Maybe since it has taken us so long you should repeat the question so that we are quite clear on it.

MR. D. POCH: Q. I just saw the 4 cents at the top of page 231 of our Exhibit 577, which is the CANDU 6 costing, for four 670 megawatt CANDU 6s, and I was just saying, that's comparable to the 3.7 cents which you offer for a 4 by 881. And I see in fact, if we compare the columns for 4 by 881 existing site and 4 CANDU 6 existing site with 2005 and 2003 dates, the numbers do in fact appear close to that.

MR. PENN: A. Yes. The numbers in this, in the 520.119 are quoted to two decimal places, whereas in the other document, 520.29, they are rounded to one decimal place, that's the reason.

Q. My question is this: Those numbers are less than 10 per cent apart, whereas when we were looking at the excerpt from Exhibit 57 a few moments ago, the DSOS, we saw much more dramatic differences in percentage terms, and I am wondering what is the explanation for that change?

A. Well, if I understand your question correctly, Mr. Poch, and you are referring now back

to --

Q. Page 219, I believe.

A. Page 211 of your--

Q. Yes, I'm sorry.

A. --document 577. That table doesn't give 4 single 600 megawatt units on the same site, it only looks at one, whereas what we have been talking about is comparing four 881s with four 600s on the same site.

Q. All right. Thank you.

If we stay with the interrogatory answer that appears at page 229 of Exhibit 577, which is .69, all the numbers you have provided here are for an assumption of four up, if you will. This isn't the one-off costs, and the one-off costs are the number of 6 or 6.7 you have given us elsewhere.

A. That's right. It lists these circumstances on page 231 of your document.

Q. And this assumes 80 per cent, the 4 --

A. Eighty per cent capacity factor, yes. That's the second bullet down on page 231.

Q. And this assumes a 40-year life?

A. Yes. It assumes in both cases 15 per cent contingency factor.

Q. All right. And this assumes an existing site. If we were to go to a new site it would be higher for that reason too, apart --

A. It would be about 9 per cent higher in costs, yes.

Q. All right. And if we wanted to maintain the flexibility to not commit to subsequent stations -- subsequent units, I'm sorry, and we want to build a single unit, perhaps with the possibility of further units on the same site, the cost of that first unit - I think we spoke of this earlier - would be in the range, about the same as a single unit, perhaps slightly more because you do more site preparation?

A. Well, that would be about right. But if in fact you committed subsequent units in a period of, say, two to three years after the first, you would probably recoup most of the advantage of building four.

Q. But you would only recoup those if you subsequently elect to build the latter units?

A. That's right. But you wouldn't clear the whole site for four. You do what they did at New Brunswick and you would clear the site for two.

Q. So on a marginal cost or system expansion cost basis, as opposed to an allocated cost basis, we should be using the higher number of perhaps

the 6.7 then for that first unit?

A. Well, we have certainly used the higher value. Just to make sure it is 6.7. Actually, is 5.79 cents per kilowatthour on an existing site.

Q. That's for an existing site in the year 2003 and we can escalate it up for a later date.

It would 6.7 for a new site?

A. That's the next -- 6.7, yes.

Q. So that first unit, if we are looking at a system expansion costing basis, those numbers would be reasonable proxies?

A. Yes, if you are just building one.

Q. Yes. And finally on this exhibit, if you turn to page 233 of our Exhibit 577, I notice in the column OM&A - it's hard to read the numbers - but apart from the first few years when you are constructing and commissioning the unit and the last year when it's being taken out of service, throughout the whole middle period the OM&A is constant, 140.7 throughout.

If the Board wanted to apply your rule of thumb that you gave us for what you are experiencing on the existing system, that is 1 per cent per year escalation, or what you are assuming for the existing system, 1 per cent per year escalation in OM&A, then we

would also have to increase these estimates for CANDU 6 for that reason?

A. Just so that we are clear, these are cash flows, of course, and I think they are in constant 1991 dollars.

THE CHAIRMAN: Excuse me, Mr. Penn. What is this table? Where does it come from? Where does it belong?

MR. PENN: Now I may need some help from others because this is a bit out of my field, but I understand this was a request --

THE CHAIRMAN: We are talking about page 233; is that right?

MR. PENN: 233.

MR. D. POCH: Just in simple terms, Mr. Chairman, 233 is still part of Exhibit 520.69, Interrogatory 9.9.43.

THE CHAIRMAN: Is it? Because it isn't in the same kind of writing and that's why I worried about it.

It does come from that?

MR. PENN: It's all part of the same interrogatory answer, Mr. Chairman.

THE CHAIRMAN: Part of your response.

MR. PENN: Yes, it was. It is just that

this table is on a very long computer sheet and it has been reduced to get it on one page.

Now, Mr. Snelson is probably a much better person to discuss this than I am. But in the Exhibit 452, the Update, the CANDU 6 is used as an illustrative example for future nuclear, and I believe that the request was for the LMSTM run. Have I got the right initials? This is outside my field.

MR. D. POCH: Yes, LMSTM.

MR. PENN: And this is the answer of that run.

MR. B. CAMPBELL: I am not sure that's actually correct, Mr. Penn. I am not sure whether this is an LMSTM output or input.

MR. PENN: I would be pleased to be corrected on it.

MR. B. CAMPBELL: You are absolutely correct that Mr. Snelson would be able to answer that question, or other planners on Panel 10.

MR. D. POCH: Q. Mr. Penn, I take it though simply from this, this cost, the 4 cents is calculated then using a level OM&A, and I take it your rule of thumb is that OM&A could be expected to increase 1 per cent per year?

MR. PENN: A. We only referred to 1 per

cent increase as an upper bound. If you remember, it was part of my direct evidence for the existing nuclear system.

Q. Yes, I understand that. You said that was the basis of your planning.

A. Pardon?

Q. You did indicate, I think, that that was what in fact you were assuming for planning purposes, 1 per cent per year.

A. For the purposes of coming up with the cost of the existing nuclear system for the balance of the planning period to the year 2014, yes.

Now, just looking at these numbers, it seems to me that they probably don't assume an increasing OM&A.

Q. Okay. And finally if you could turn to page 235, the last page of Exhibit 577, Interrogatory 9.7.140.

THE REGISTRAR: 520.120.

---EXHIBIT NO. 520.120: Interrogatory No. 9.7.140. (Page 235 of Exhibit 577)

MR. D. POCH: Q. We asked you to sum up your experience with nuclear technology, has it been a success, in what ways has it been a success and in what ways has it been a disappointment.

Perhaps the answer is a disappointment to us because you didn't bother listing any disappointments.

But just focus on the bottom paragraph, you say:

> While there are examples of costs in schedules exceeding the original plans, they have not been of sufficient magnitude to eliminate the economic competitiveness of nuclear generation. The problems have not exceeded those that Hydro expected to encounter in the development of a new source of electrical energy.

Do you mean that statement to cover the scale of problems you have had at Darlington?

[4:58 p.m.]

MR. PENN: A. We have to be careful in thinking about the so-called problems at Darlington.

If you discount the planned schedule changes and you focus on the generator/rotor problem and the primary heat transport problem, as both Mr. Daly and I have testified, we are very hopeful based on current understanding that both problems will be resolved this year.

On that basis, and if you recall the graph I put up on the screen only about three or four days ago - in fact, I think you were cross-examining me at the time, those capital costs in dollars per kilowatt going from Pickering to Darlington didn't show any dramatic change from the general trend by Darlington.

In fact, if you compare Ontario Hydro's nuclear costs and generating costs, especially LUECs, with other world nuclear utilities, if you accept that that is a reasonable measure, you will find that the Ontario program has been extremely successful.

Q. Mr. Penn, just in respect to my question particularly then, I take it you would not apply that statement to Darlington if you include the costs of the delays you have spoken of?

A. Well, in constant dollars I would because if you take the EUCG data, which is --

Q. Well, no, I am not referring to your international comparison. I am just referring to the application of this answer here, where you say:

> The problems have not exceeded those that Hydro expected to encounter in development of a new source of electrical energy.

And I am just wondering if you were there referring to the problems you have experienced, the costs you have seen rise at Darlington, including -- for whatever reason those costs and delays arose, and I am wondering if you would have that answer apply to Darlington or not.

A. The increase in costs at Darlington have undoubtedly been troublesome, but I think, as I've tried to say before and if you look at Interrogatory 8.2.14 which provides graphs, including four per cent real interest, it shows that the Darlington costs aren't significantly out of line with the history of our experience in building nuclear plant in this province, and compared with other people in the world it is still competitive.

Q. So you would then apply this statement to include the scales of problems in cost escalation that we have witnessed at Darlington, then?

A. I think Darlington is marginally getting above the trend.

Q. All right. So if we were to build a new generation of reactors 10 or 15 years from now problems of a similar scale and cost escalation of a similar scale to that we have seen at Darlington above originally envisaged would not be, in the words of your

answer here: beyond those expected to be encountered?

A. No, I don't think they would be beyond what we expect to encounter, and I would be delighted, if I am permitted, to put the future cost of nuclear power in context with the present costs to indicate that our assumptions are quite reasonable.

This information, Mr. Chairman, is taken from the EUCG data, Interrogatory 8.2.14. It doesn't have any of the American information on it.

It includes interest at four per cent real rate and has Darlington at the current dollars per kilowatt of the cost that I have reported at this hearing, the latest costs. To the right are the various nuclear operations and ranges that I have provided at this hearing for future plants.

The point I am trying to make is the costs that we are predicting in the future are generally in line with the type of experience that we have had in the past.

Q. And just to clarify then, this refers to capital costs; I take it dry costs?

A. These are the total dry costs, yes.

Q. And I take it that the range shown for CANDU in the year 2010, the lower box would be your estimate that you have provided for the cheaper CANDU

options you have identified, which tend to be the 4 by 881 --

A. The 4 by 881 on the existing site.

Q. So you are showing it at a point much lower than if we were to place a trend line through the existing ones and projected upwards?

A. It is about 13 per cent less than Darlington.

Q. And the one that appears to be on the trend line from my call at the top of that range, that would be for a...

A. Four by 516 megawatt plant.

Q. All right.

A. Pickering "B" style, on a new site.

Q. On a new site, okay.

A. Yes. And then the others are as the legend states at the bottom.

MR. D. POCH: Thank you, Mr. Chairman. Those are my questions.

THE CHAIRMAN: Perhaps that document, that should be marked as an exhibit. Next number?

MR. B. CAMPBELL: If we could get a number we will provide copies tomorrow.

THE REGISTRAR: Thank you. 641.

---EXHIBIT NO. 641: Reserved.

THE CHAIRMAN: That will complete today's hearing.

Mr. Greenspoon, you are next up; is that right?

MR. GREENSPOON: That's right.

THE CHAIRMAN: That will be next month morning. We are not sitting tomorrow. Next Monday morning.

I should just remind those that we are not sitting one day next week. I think it is Wednesday the 29th we are not sitting.

MR. D. POCH: A number of counsel are in another hearing, or had just better be, including myself.

THE CHAIRMAN: Wednesday the 29th we aren't sitting. Like press reports, I don't pay any attention to other hearings. [Laughter].

The 29th we will not be sitting, but we will be sitting on Monday the 27th, the 28th, and on Thursday the 30th. We will adjourn until Monday.

THE REGISTRAR: This hearing will adjourn until Monday morning next at 10 of the clock.

---Whereupon the hearing was adjourned at 5:07 p.m. to be reconvened at ten o'clock, Monday, April 27th, 1992.

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